GEORGIA INSTITUTE OF TECHNOLOGY — OFFICE OF CONTRACT ADMINISTRATION

PROJECT ADMINISTRATION DATA SHEET

[x] ORIGINAL [ ] REVISION NO. _____

Project No. A-3256 DATE 6/23/82

Project Director: James L. Burson MISC ~~XXXXX~~ School/Lab EDL/SHS

Sponsor: PGO, Centers for Disease Control

Type Agreement: Contract No. 200-82-0008

Award Period: From 5/19/82 To 6/18/82 (Performance) 6/18/82 (Reports)

Sponsor Amount: $6,100 (fixed price) Contracted through:

Cost Sharing: _____ GTRI/~~GIT~~

Title: Asbestos Monitoring at Centers for Disease Control

ADMINISTRATIVE DATA OCA Contact Faith G. Costello

1) Sponsor Technical Contact:

Mr. Ron Wallace, Ms. Gailya Walter
Centers for Disease Control
255 East Paces Ferry Rd. NE
Atlanta, GA 30305

(404) 262-6571

2) Sponsor Admin/Contractual Matters:

John L. Williams
Centers for Disease Control
255 East Paces Ferry Road, NE
Atlanta, GA 30305

Defense Priority Rating: NA Security Classification: NA

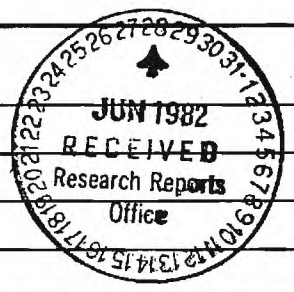
RESTRICTIONS

See Attached NA Supplemental Information Sheet for Additional Requirements.

Travel: Foreign travel must have prior approval — Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of $500 or 125% of approved proposal budget category.

Equipment: Title vests with NA

COMMENTS:



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~~Contract Input~~
Project File
Other GTRI

FORM OCA 4:781

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION SHEET

Date 6/25/82

Project Title: Asbestos Monitoring at Centers for Disease Control

Project No: A-3256

Project Director: James L. Burson

Sponsor: PGO, Centers for Disease Control

Effective Termination Date: 6/18/82

Clearance of Accounting Charges: 6/18/82 (Fixed Price)

Grant/Contract Closeout Actions Remaining:

- [x] Final Invoice and Closing Documents
- [ ] Final Fiscal Report
- [ ] Final Report of Inventions
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other _____

Assigned to: EDL/SHS (School/Laboratory)

COPIES TO:

Administrative Coordinator	Research Security Services	EES Public Relations (2)
Research Property Management	~~Reports Coordinator~~ (OCA)	Computer Input
Accounting	Legal Services (OCA)	Project File
Procurement/EES Supply Services	Library	Other _____

FORM OCA 10:781

SUMMARY REPORT OF AIR SAMPLING AND WORK PRACTICE MONITORING

at

THE CENTERS FOR DISEASE CONTROL
1600 Clifton Road
Atlanta, Georgia

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Occupational Safety and Health Branch
Atlanta, Georgia
June 17, 1982

SUMMARY REPORT OF AIR SAMPLING AND WORK PRACTICE MONITORING
at

THE CENTERS FOR DISEASE CONTROL
1600 Clifton Road
Atlanta, Georgia

INTRODUCTION

The Georgia Tech Research Institute performed industrial hygiene air sampling during the CDC asbestos abatement project No. P-3012 A. In addition to the results of daily air sampling, reports of contractor work practices were delivered to CDC Biosafety personnel each day of the project. All air sampling and work practice monitoring was performed by William M. Ewing or Kenneth E. Johnson under the direction of Mr. James L. Burson, CIH of Georgia Tech. Copies of the daily air sampling results and work practice monitoring reports have been included in Appendices A and B, respectively. A copy of the sampling and analytical method used to evaluate airborne concentrations of asbestos fibers is included in Appendix C. Copies of the Occupational Safety and Health Administraiton (OSHA) asbestos standard (29 CFR 1910.1001) and the Environmental Protection Agency's (EPA) National Emission Standard (40 CFR 61.20) for asbestos are included in Appendix D.

DESCRIPTION OF WORK AREAS

Three work areas were designated by the CDC as work areas A, B and C. The work was performed by the contractor (Specialty Insulation Services) in the same sequence (A, B, then C). Work areas A and B were the areas where asbestos-containing fireproofing was removed. Work area C involved erecting an enclosure (barrier) between the fireproofing and the room.

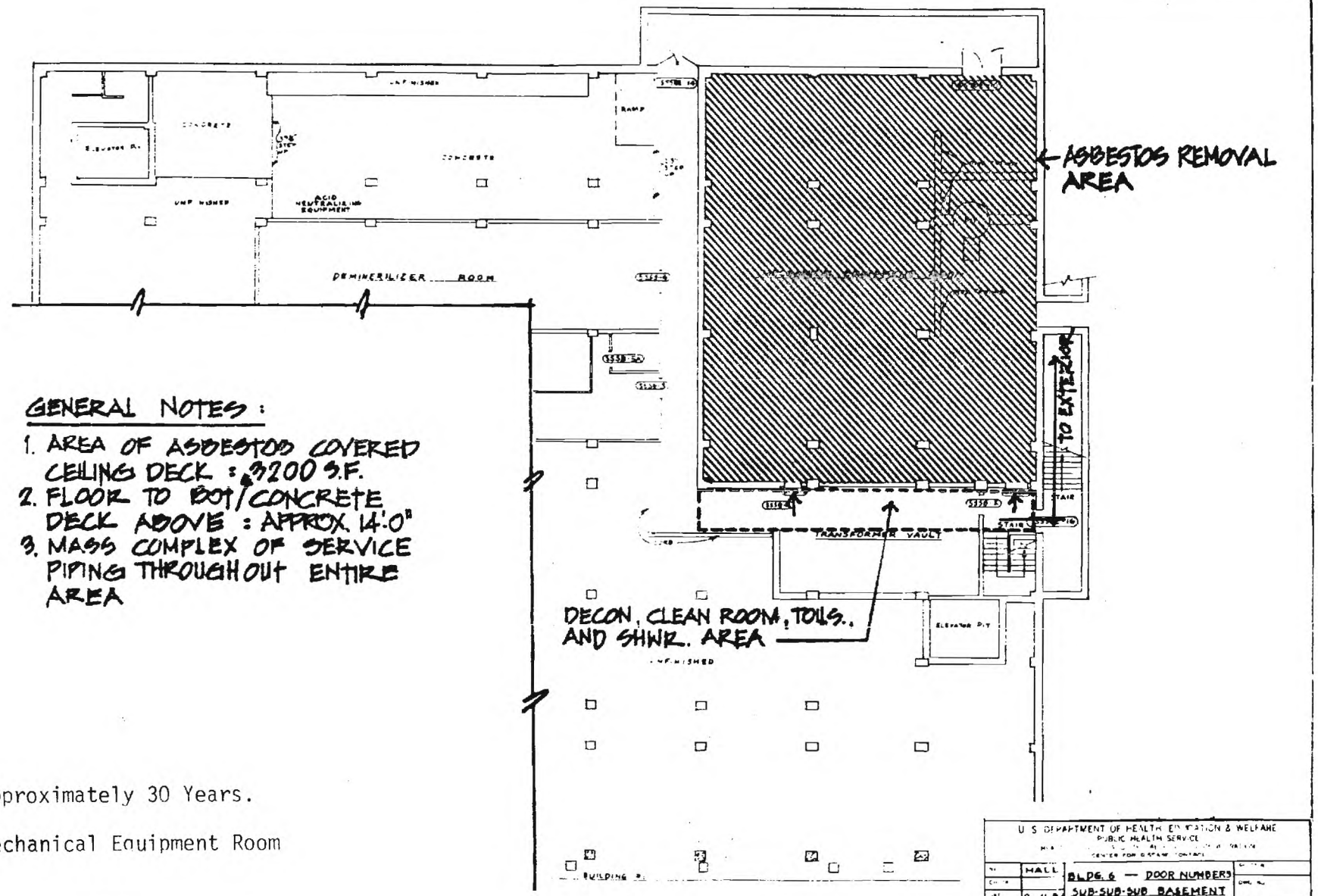
WORK AREA A

Work area A includes the mechanical equipment room of building 6 (sub-sub-sub basement). The areas of asbestos-containing fireproofing (chrysotile) to be removed from the ceiling deck was approximately 3200 square feet. Work area A was divided into two areas, the mechanical room and the air intake room. The mechanical room contains numerous service piping throughout. The air intake room contains the filters, blower, and intake ports for building supply air. All work involving asbestos was performed during the long Memorial Day weekend (May 29-31, 1982) when the air supply system was shut off and sealed. The approximate age of this building is 30 years. Figure I indicates the area designated work area A.

WORK AREA B

Work area B was located in the basement of building 2 and consisted of two projection rooms. These two rooms housed audio-visual equipment for three adjoining classrooms. The asbestos-containing material consisted of troweled-on accoustical insulation covering the walls and ceiling of each room. This material, containing chrysotile encompassed a total area of approximately 2100 square feet. The age of the material was estimated to be 25 years. Removal activities occurred at these locations during June 2-6, 1982. Figure II is a sketch of work area B.

Figure I



GENERAL NOTES:

1. AREA OF ASBESTOS COVERED CEILING DECK : 3200 S.F.
2. FLOOR TO BOT/CONCRETE DECK ABOVE : APPROX. 14'-0"
3. MASS COMPLEX OF SERVICE PIPING THROUGHOUT ENTIRE AREA

AGE: Approximately 30 Years.

USE: Mechanical Equipment Room

U.S. DEPARTMENT OF HEALTH EDUCATION & WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL

HALL

BLDG. 6 — DOOR NUMBERS
SUB-SUB-SUB BASEMENT

ENGINEERING SERVICES
1600 CLIFTON RD.

DRAWING A-1

WORK AREA A

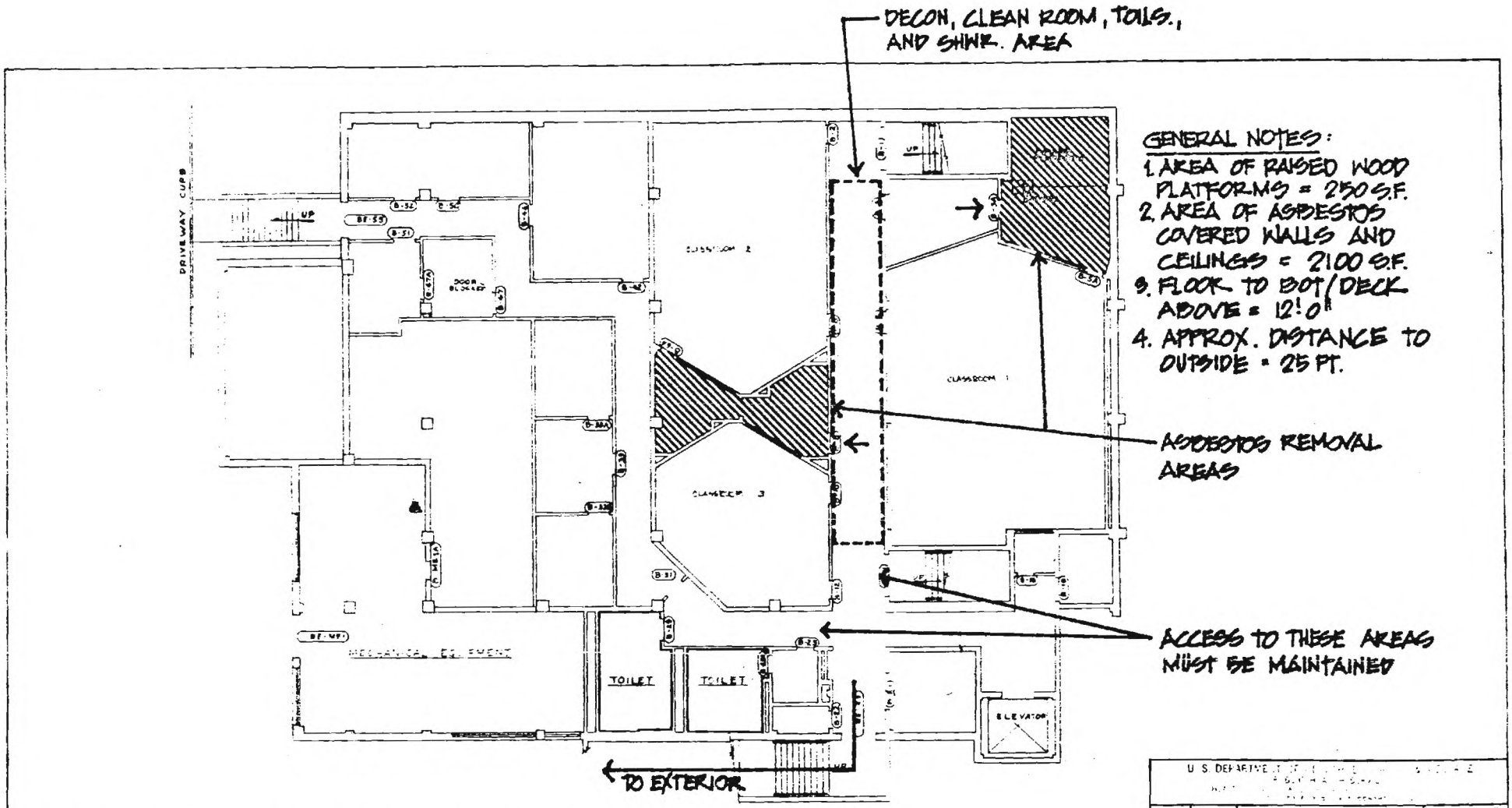


Figure II

AGE; Approximately 25 Years USE: Projection Rooms

DRAWING A-2

WORK AREA B

WORK AREA C

Work area C consists of a storage and projection room on the first floor of building 2. Since no direct contact with the fireproofing was anticipated during construction of the enclosure, this area was not treated as an asbestos-contaminated work area. It should be noted, however, that air sampling was conducted during the construction and installation of the barrier. The barrier consisted of approximately 200 square feet of polyethylene and sheetrock to enclose chrysotile-containing fireproofing material. This work was performed on June 7, 1982, and is depicted in Figure III.

DISCUSSION - AIR SAMPLING

Prior to the start of any removal preparations air sampling was conducted in each of the three work areas to establsh existing fiber concentrations before removal or enclosure. In work areas A and B three samples were collected in each area. These results are included in Table A-1, Appendix A. For work area A all samples indicated fiber concentrations of less than 0.01 fibers (greater than 5 micrometers in length) per cubic centimeter of air (fibers/cc). In work area B samples indicated fiber concentrations of less than 0.01 fibers/cc for one sample and 0.01 fibers/cc for the other two samples. In work area C, fiber concentrations for two samples were recorded of less than 0.01 fibers/cc and 0.01 fibers/cc, respectively.

During removal activities in work areas A and B air sampling ws conducted in accordance with the scheme outlined in the contract specifications of the CDC. This included the following schedule.

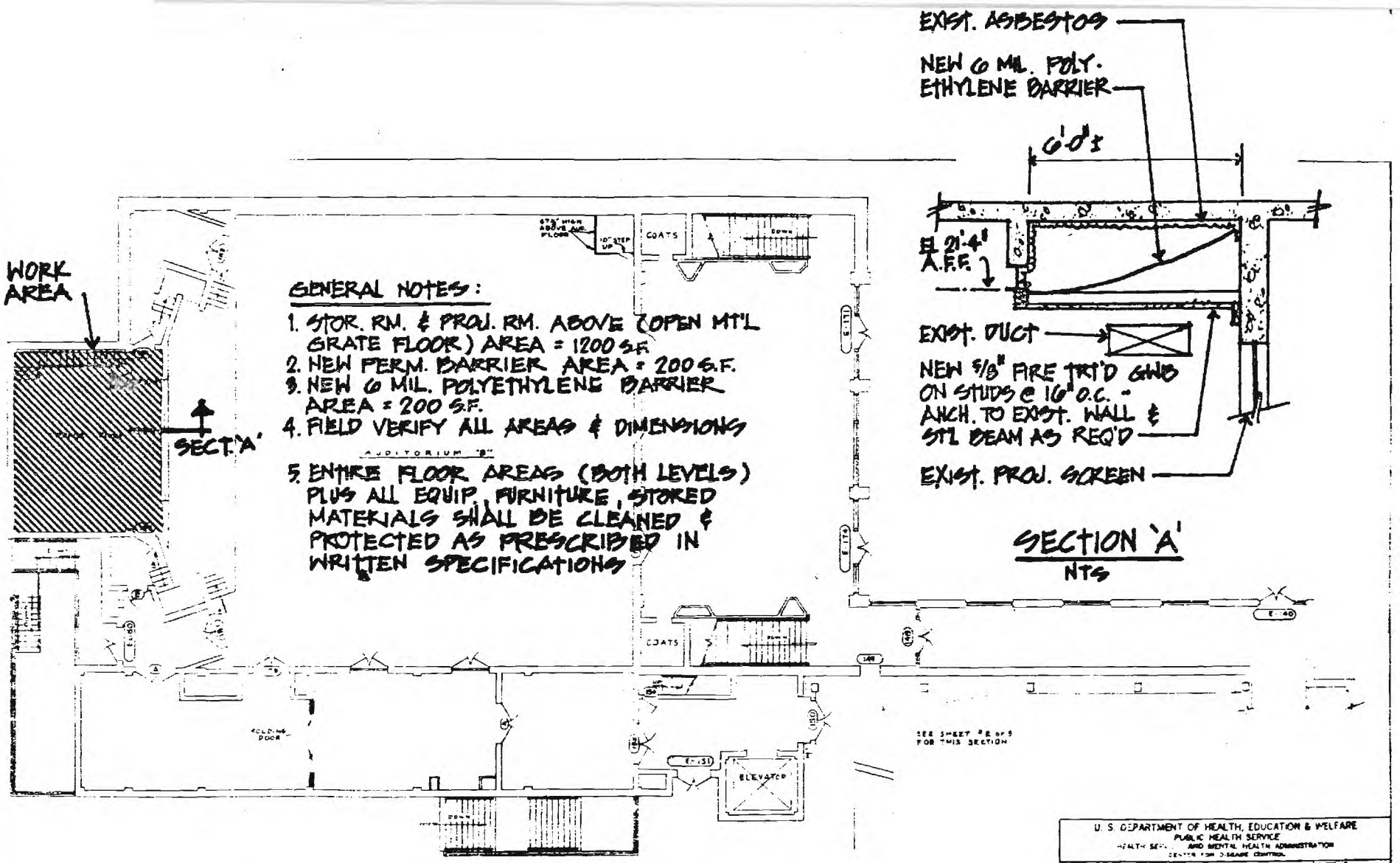
AREAS TO BE SAMPLED	MINIMUM NO. OF SAMPLES EACH DAY	MINIMUM AIR VOLUME (LITERS)
Work area	4	60*
Outside work area barriers	2	120
Outside building	2	240

*Several samples taken in work area B were overloaded during scraping activities, for this reason some samples were repeated using a reduced air volume to prevent overloading of the filter.

In work area C air sampling was conducted in accordance with the following schedule adopted by the CDC.

AREA TO BE SAMPLED	MINIMUM NO. OF SAMPLES PER DAY	EACH SAMPLE MINIMUM VOLUME (LITERS)
Work area	2	60
Outside building	1	240

Figure III



AGE: Approximately 30 Years. USE: Storage room and projection room.

DRAWING A-3

WORK AREA C

In addition, personal sampling was conducted on selected contractor employees during removal activities in work areas A and B. Also, additional area samples were collected as needed.

Air sampling was conducted in work areas A and B following final clean-up. Three samples were collected in each of these areas and repeated as necessary until the fiber concentrations obtained met with the approval of CDC's Office of Biosafety for re-entry by unprotected personnel.

A summary of all air sampling results has been prepared and compiled in Table I of this report. It should be noted that the mean fiber concentrations reported are simple averages of the concentrations indicated. Time-weighted averages for multiple samples collected over several days would not have been appropriate in this instance.

DISCUSSION - WORK PRACTICE OBSERVATIONS

Copies of the daily inspection checklists furnished to the CDC Office of Bisafety have been included in Appendix B. Although one time is reported on each checklist the comments and observations included are summaries of the full day's observations. Most inspections were performed by the industrial hygienist and the safety professional from Georgia Tech. Copies of the daily reports were also furnished to Specialty Insulation Services (Contractor) at the request of Mrs. Walter of the CDC Office of Biosafety. Included in the daily report were work area observations, use of personal protective equipment and evaluation of work practices. Also included were comments on disposal practices and safety considerations.

WORK AREA OBSERVATIONS

The work areas (A and B) were noted as physically isolated from all other areas through the use of plywood barriers or locked doors. In work area B three layers of polyethylene plastic was used at the end of a hallway to isolate the work area from other areas of the building. All openings to the work areas were sealed with plastic and/or duct tape. It was noted that in each work area an alternative means of egress was made available in case of an emergency such as a fire. Air movement systems were shut off in each work area througout the abatement process and not restarted until fiber concentrations were reduced after final clean-up to a level satisfying the CDC Office of Biosafety. In addition to shut-down of the air handling systems all supply and return air grills were sealed in two layers (minimum) of plastic and duct tape.

Surrounding the perimeter of each work area (A and B) signs were placed warning of the asbestos hazard. Additionally, OSHA and EPA regulations were maintained on site at each work area.

Decontamination facilities were constructed at each work site (A and B). These facilities included a clean change room for contractors and authorized vistors to remove street clothes and darn personal protective equipiment. An airlock consisting of three layers of polyethylene plastic separated the clean room from the portable shower. Another airlock separated the shower from the contaminanted equipment room.

TABLE I

SUMMARY OF AIR SAMPLE RESULTS

I. WORK AREA A

No. of Samples	Description	Range Fibers/cc	Mean Fibers/cc
3	Pre-work samples	<0.01	<0.01
12	Work area (personal & area)	0.03-2.6	1.04
4	Outside work area in building	0.01-0.02	0.02
4	Outside building	<0.01	<0.01
3	Post-work sampling I	0.01-0.05	0.03
3	Post-work sampling II	<0.01	<0.01

II. WORK AREA B

No. of Samples	Description	Range Fibers/cc	Mean Fibers/cc
3	Pre-work samples	<0.01-0.01	0.01
12	Work area (personal & area)	0.36-147.	29.8
6	Outside work area in building	0.02-0.09	0.06
6	Outside building	<0.01-0.08	0.02
3	Post-work sampling I	0.15-0.22	0.19
3	Post-work sampling II	<0.01-0.01	<0.01

III. WORK AREA C

No. of Samples	Description	Range Fibers/cc	Mean Fibers/cc
2	Pre-work samples	< 0.01-0.01	0.01
2	Work area samples	0.04-0.07	0.06
1	Outside work area in building	<0.01	< 0.01
1	Outside building	0.02	0.02

The work areas were all within the CDC secured complex which reduced the chance of non-authorized personnel entering a contaminanted area. It was noted that no persons other than contractor personnel and safety and health inspectors were observed entering the contaminanted areas.

Several items on the daily report contain the comment "not applicable" and observe a brief mention here. Negative pressure was not maintained in the work area since it was not required by the contract. Evidence of medical exams for contractor personnel were supposed to be furnished to the CDC contractng officer and not the Georgia Tech representative. Mrs. Walter of the CDC Office of Biosafety informed the Georgia Tech personnel that this was completed prior to the start of removal activities. Lastly, a lockbox for valuables located in the change room was an optional item which the contractor chose not to supply.

PERSONAL PROTECTIVE EQUIPMENT

The daily report included comments concerning the use of personal protective equipment (including respirators) by the contractor personnel. In work areas A and B, supplied-air respirators (full face) were used by contractor personnel during all scraping and gross clean-up activities. During final clean-up half-mask, dual cartridge filter respirators were used after air sampling data indicated this type of respirator could be employed according to the specifications ofthe contract and the OSHA asbestos standard (29 CFR 1910.1001). It was noted that all respirators used by the contractor personnel and other authorized visitors in the contaminanted areas were approved by the National Institute for Occupational Safety and Health (NIOSH) for use in atmospheres containing asbestos. Contractor personnel were observed wearing disposable coveralls, head covering and foot/shoe covering when in the work area (A and B). On several occassions it ws noted that the disposable coveralls were not worn properly by the contractor personnel. This and other items concerning personal protective equipment is detailed in the daily reports enclosed in Appendix B of this report.

WORK PRACTICES

The daily reports included comments regarding the employees work practices throughout the removal activities. Prior to the start of any removal the CDC had moved all non-permanent items from each work area (A and B). The contractor sealed all remaining stationary items in plastic with the exception of several hot pipes in work area A. In work area A the floors and walls were completely covered in the air intake side and partially covered in the mechanical room side. Due to the numerous pipes, etc. in the mechanical room it was not feasible to cover all portions of each wall. Some areas of the floor in this side could have been covered but were not. Upon final clean-up, the floor was recleaned and sealed with asbestos sealent to encapsulate any remaining fibers. This item had been addressed in the daily report (See Appendix B).

No workers were observed in the work area without respiratory equipment. The contractor personnel were observed using the shower upon exiting the work area and disposing of contaminanted clothing in a disposal bin provided for this purpose.

In work area A wet methods were employed using the EPA-recommended wetting agent which proved successful in significantly reducing fiber emissions into

workplace air. The air sampling results contained in Appendix A support this conclusion. In work area B wet methods were utilized as well with only limited success. The fireproofing was, at times, 6-8 inches thick and had been painted which hindered water absorption. An injection method was tried using 12 inch wands (¼ ich diameter) to inject water into the material. This proved to be only marginally successful since the water tended to channel through the material and leak out the bottom of the wall rather than be absorbed. It is for this reason primarily that the fiber concentrations were much higher in work area B.

Several comments were made in the daily reports concerning the disposal of asbestos-containing waste (see Appendix B). Briefly, waste from areas A and B was placed in fiberboard drums containing 6 mil polyethylene bags. All waste was bagged while wet. Other contaminanted materials (disposable clothing, barriers, etc.) were diposed of in a similar manner. The bags were properly labeled as asbestos-containing waste, however only some of the drums were properly labeled. The waste was, according to the contractor and notification supplied to the State of Georgia, Department of Natural Resources, disposed of at the Dekalb County Landfill rather than the Morgon Falls Landfill as originally planned. Verification of disposal (trip tickets) were not required by the contract.

SAFETY

Throughout the project, Mr. Ken Johnson of Georgia Tech included comments regarding safety hazards at the work areas. These are detailed in the daily reports found in Appendix B. The primary problem was the existance of several electrical hazards due to the use of water and electricity together. Ungrounded wiring was often found in standing water or attached to a metal ladder creating a hazard. Several employees of the contractor and Georgia Tech personnel were shocked when walking in the contaminanted area, however, no one experienced any problems requiring medical attention. Tripping hazards were numerous but unavoidable due to the many air-supply lines necessary for the respiratory equipment.

MISCELLANEOUS

On June 4, 1982 Mr. Marvin Bradford from the State of Georgia, Department of Natural Resources, Environmental Protection Division visited work area B while removal activities were in progress. He discussed the project with Mr. William Ewing of Georgia Tech and inspected the area. He verbally commented that he did not observe any deficiencies or violations of the Georgia asbestos standard. A copy of the EPA asbestos standard (ambient air, emissions) which is identical to the Georgia standard is included in Appendix D of this report.

This report prepared by:

[redacted]
William M. Ewing
Industrial Hygienist

[redacted]
Kenneth E. Johnson
Safety Professional

This report reviewed and approved by:

[redacted]
James L. Burson, CIH
Program Manager

APPENDIX A

RESULTS OF AIR SAMPLING

Table A-1

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant CDC, 1600 Clifton Road, Atlanta, Georgia

Work Areas A, B, C

Materials Fibers greater than 5 micrometers in length

Date 1982	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers* per Filter	Fibers * per cc air
5/28	AA-011-04	Area Sample, Area A, South end of boiler room	0915	1653	916	458	7000	<0.01
5/28	AA-011-08	Area Sample, Area A, North end of boiler room	0915	1653	916	458	5000	<0.01
5/28	AA-011-62	Area Sample, Area A, Outside North end of boiler room	0916	1654	916	458	6000	<0.01
5/28	AA-011-43	Area Sample, Area B, Projection room #3	0934	1633	838	419	12,000	0.01
5/28	AA-011-06	Area Sample, Area B, Projection room #2	0934	1635	842	421	9000	0.01
5/28	AA-011-02	Area Sample, Area B, Projection room #1	0938	1634	832	416	5000	<0.01
5/28	AA-011-40	Area Sample, Area C, Top of electrical box	0946	1642	832	416	3000	<0.01
5/28	AA-011-10	Area Sample, Area C, Center of floor grille	0947	1642	830	415	9000	0.01

*Greater than 5 micrometers in length

Table A-2

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant CDC, 1600 Clifton Road, Atlanta, Georgia — **Materials** Fibers greater than 5 micrometers in length

Work Area A (Building No. 6, Mechanical Rooms)

Date 1982	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers* per Filter	Fibers* per cc Air
5/29	AA-011-57	J. Jackson, supervisor, throughout entire work area	1911	2032	162	81	6000	0.04
5/29	AA-011-12	R. Price, wet scraping in air intake mixing room	1923	2032	138	69	180,000	1.3
5/29	AA-011-07	Area Sample, work area, by door of intake air mixing room	1913	2032	158	79	380,000	2.4
5/29	AA-011-20	Area Sample, work area, center of boiler room, west wall	1925	2037	144	72	5000	0.03
5/29	AA-011-46	Area Sample, work area, boiler room, near south door	1907	2032	170	85	450,000	2.6
5/29	AA-011-31	Area Sample, work area, enclosure north of boiler room	1913	2032	158	79	180,000	1.1
5/29	AA-011-26	Area Sample, outside work area in stairwell north of boiler room	1838	2046	256	128	4000	0.01
5/29	AA-011-14	Area Sample, outside work area, above work area by door to c-6	1840	2047	254	127	3000	0.01
5/29	AA-011-03	Area Sample, outside building, above entrance to clean room	1828	2057	298	149	2000	<0.01
5/29	AA-011-47	Area Sample, outside building, above waste load-out door	1840	2047	286	143	<2000	<0.01

*Greater than 5 micrometers in length

Table A-3

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant CDC - 1600 Clifton Rd., Atlanta, Georgia

Materials Fibers greater than 5 micrometers in length

Work Area A - (Building Number 6, Mechanical Rooms)

Date 1982	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc Air
5/30	AA-011-09	Area Sample Work area, North Enclosure	1424	1454	60	30	7,000	0.12
5/30	AA-011-48	Area Sample Work area, Boiler Room, Center	1418	1449	62	31	150,000	2.4
5/30	AA-011-50	Area Sample Work Area Boiler Room, North Door	1420	1451	62	31	80,000	1.3
5/30	AA-011-65	Area Sample Work Area Boiler Room, South Door	1426	1456	60	30	70,000	1.2
5/30	AA-011-66	Area Sample Outside Work Area In North Stairwell	1355	1604	258	129	5,000	0.02
5/30	AA-011-42	Area Sample Outside Work Area Near Rm. C-6 Above work area	1357	1605	256	128	5,000	0.02
5/30	AA-011-30	Area Sample Outside Building Above Clean Room Entrance	1347	1610	286	143	< 2,000	< 0.01
5/30	AA-011-05	Area Sample Outside Building Above Waste Loading Door	1348	1610	284	142	< 2,000	< 0.01

Table A-4

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant CDC, 1600 Clifton Road, Atlanta, Georgia

Work Area A - (Building 6, Mechanical rooms)

Materials Fibers greater than 5 micrometers in length

Date 1982	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers*per Filter	Fibers*per cc Air
5/31	AA-011-45	Area Sample, next to center air intake in mixing room	1632	2055	528	264	5000	0.01
5/31	AA-011-44	Area Sample, center of supply air mixing room	1631	2055	526	263	27,000	0.05
5/31	AA-011-13	Area Sample, Center of boiler room, 5 ft. from west wall	1632	2055	526	263	11,000	0.02

*Greater than 5 micrometers in length

Table A-5

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant CDC, 1600 Clifton Road, Atlanta, Georgia

Work Area A, All work completed, building 6 upper floors

Materials Fibers graeter than 5 micrometers in length

Date 1982	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc Air
6/1	AA-102	Area Sample, Building 6, SSB, above mechanical room	1325	1644	398	199	3000	<0.01
6/1	AA-100	Area Sample, Building 6, Store-room #166, First floor	1332	1648	392	196	2000	<0.01
6/1	AA-104	Area Sample, Building 6, Room #270, Second floor	1336	1650	388	194	2000	<0.01

Table A-6

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant CDC, 1600 Clifton Road, Atlanta, Georgia

Area B (Building 2, Projection Rooms)

Materials Fibers greater than 5 micrometers in length

Date 1982	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc Air
6/2	AA-011-36	Area Sample, Center of north projection room	1447	1502	30	15	1,700,000	58.*
6/2	AA-011-70	Area Sample, Center of South projection rooms (west room)	1450	1505	30	15	4,400,000	147.*
6/2	AA-011-82	Area Sample, Center of hallway between projection rooms	1454	1536	84	42	1,400,000	18.*
6/2	AA-011-34	Area Sample, Decontamination area, clean rm, S. of shower	1650	1715	50	25	63,000	1.3
6/2	AA-011-33	Area Sample, Outside work area, south auditorium stairwell	1406	1744	436	218	11,000	0.02
6/2	AA-011-32	Area Sample, Outside work area, north auditorium stairwell	1406	1744	436	218	37,000	0.08
6/2	AA-011-01	Area Sample, Outside building, 3 ft. east of pit by door	1359	1747	456	228	3000	<0.01
6/2	AA-011-64	Area Sample, Outside building, 3 ft. south of pit	1359	1747	456	228	8000	0.02
6/2	AA-011-11	E. Hill, Scraping north booth	1340	1443	126	63	Overloaded,	no count
6/2	AA-011-27	E. Hill, Scraping north booth	1508	1536	56	28	2,700,000	48.*
6/2	AA-011-69	M. King, Scraping south booth	1340	1452	144	72	Overloaded,	no count
6/2	AA-011-67	M. King, Scraping south booth	1452	1525	66	33	Overloaded,	no count

*Due to heavy loading of particulate matter these results may be lower than actual fiber concentrations.

Table A-7

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant CDC, 1600 Clifton Road, Atlanta, Goergia
Work Area B (Building 2, projection rooms)

Materials Fibers greater than 5 micrometers in length

Date 1982	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc Air
6/3	AA-011-58	Area Sample, work area B, north projection booth	0923	0937	28	14	540,000	19.
6/3	AA-011-53	Area Sample, work area B, south projection booth	0927	0941	Void	Void	(filter wet & damaged)	
6/3	AA-011-39	Area Sample, work area B, center of hallway	0921	0941	40	20	14,000	0.36
6/3	AA-011-59	Area Sample, work area B, center of contaminated equipment room	0918	0940	44	22	30,000	0.69
6/3	AA-011-38	Area Sample, inside building, outside work area beyond men,s rm.	0849	1002	146	73	14,000	0.09
6/3	AA-011-77	Area Sample, outside work area, north auditorium stairwell	0851	1005	148	74	14,000	0.09
6/3	AA-011-16	Area Sample, outside building 2, 3 feet east of pit	0839	1040	242	121	2000	0.01
6/3	AA-011-91	Area Sample, outside bldg 2, 3 ft south of pit during waste loading	0839	1040	242	121	18,000	0.08

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant CDC, 1600 Clifton Rd., Atlanta, Georgia

Materials Fibers greater than 5 micrometers in length

Work Area B - Projection Rooms - After Cleaning

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc Air
6/4	AA-127	Area Sample- Room B-46 Basement Level	0952	1206	268	134	3,000	0.01
6/4	AA-114	Area Sample - Inside Bldg. by Barrier next to Men's Room	0952	1204	264	132	3,000	0.01
6/4	AA-121	Area Sample North Auditorium Stairwell	0950	1200	260	130	9,000	0.04
6/4	AA-113	Area Sample South Auditorium Stairwell	0950	1200	260	130	9,000	0.04
6/4	AA-118	Area Sample - North Projection Room - Dry Brushing Walls	1119	1123	8	4	320,000	40.
6/4	AA-115	Area Sample - In hallway between Proj. Rooms being brushed	1115	1133	36	18	26,000	0.74
6/4	AA-108	Area Sample - S. Proj. Room near hall - Dry Brushing in next rm	1121	1129	16	8	100,000	6.3
6/4	AA-120	Area Sample - S. Proj. Rm. - far room while dry brushing	1121	1126	10	5	180,000	18.

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant CDC , 1600 Clifton Rd. Atlanta, Ga.

Work Area B - Projection Rooms - Final Cleanup

Materials Fibers Greater than 5 Micrometers in length

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc Air
6/6	AA-126	Area Sample- Middle of Hallway	1027	1627	720	360	140,000	0.19
6/6	AA-125	Area Sample- center of N. Proj.rm	1027	1627	720	360	100,000	0.15
6/6	AA-112	Area Sample- S. proj rm.- near door	1027	1627	720	360	160,000	0.22

GEORGIA INSTITUTE OF TECHNOLOGY
Engineering Experiment Station
Safety & Health Services

INDUSTRIAL HYGIENE SAMPLING SUMMARY

Plant CDC, 1600 Clifton Rd, Atlanta, GA
Work Area B, Final Clean-Up
Work Area C

Materials Fibers greater than 5 micrometers in length

Date	Sample Number	Description	Sampling Period		Sample Volume (Liters)	Sample Time (Min.)	Concentration	
			Start	Stop			Fibers per Filter	Fibers per cc Air
6/7/82	AA-110	Area Sample - Outside Bldg. on landing outside Area C	1008	1210	244	122	3,800	0.02
6/7/82	AA-124	Area Sample - Work Area C - S. Wall near Electr. Panel	1014	1049	70	35	4,500	0.07
6/7/82	AA-105	Area Sample - Work Area C - N. Wall above stairs	1013	1048	70	35	3,000	0.04
6/7/82	AA-107	Area Sample - Work Area B - S. Proj. Rm. - Near Door	1101	1712	742	371	10,000	0.01
6/7/82	AA-108	Area Sample - Work Area B - N. Proj. Rm. - Center of Platfm.	1102	1711	738	369	5,000	<0.01
6/7/82	AA-106	Area Sample - Work Area B - Middle of Hallway	1100	1710	740	370	3,000	<0.01
6/7/82	AA-123	Area Sample - Audio-Visual Room	1201	1653	584	292	2,300	<0.01

GEORGIA INSTITUTE OF TECHNOLOGY
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OCCUPATIONAL SAFETY AND HEALTH SERVICES

Investigator's Survey Checklist

Investigator: William Ewing Date: 5/29/82 Time: 1900

Location: CDC, 1600 Clifton Rd., Atlanta, Building 6, Mech Rooms

Project Engineer: Mr. Ron Wallace Phone: (404) 329-3883

Project Administrator: Mrs. Gailya Walters Phone: (404) 329-3883

Contractor Name and Address: Specialty Insulation Services
Atlanta, GA
Phone: (404) 435-0139

WORK AREA OBSERVATIONS	Yes	No	Comments
1. Work area isolated? (note how)	X		Polyethylene & Plywood
2. All openings to work area sealed?	X		
3. Air movement system sealed off?	X		
4. Negative pressure maintained in work area? How?		X	N/A
5. Warning signs at all entrances/exits?	X		
6. Entrance to work area securable?	X		
7. EPA and OSHA regulations posted on site?	X		
8. Number of workers in area 7			
9. Evidence of medical exams for each worker?			N/A

PERSONAL PROTECTIVE EQUIPMENT			
1. NIOSH approved respirators? Type? Type C Air Supplied	X		
2. Disposable coveralls?	X		
3. Head covering?	X		
4. Foot/shoe covering?	X		

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CHANGE ROOM	Yes	No	Comments
1. Hangers/lockers/bins for street clothes?	X		
2. Lockbox for valuables?			N/A
3. Shower available on-site?	X		
4. Airlock to shower?	X		
5. Sanitary conditions maintained?	X		
6. Airlock to inside change room?	X		
7. Disposal bin for protective equipment?	X		
8. Airlock to work area?	X		

WORK PRACTICES			
1. Are wet methods employed?	X		
2. EPA-recommended wetting agent used?	X		
3. Are HEPA filter vacuums used?			N/A at this stage of removal
4. Are light fixtures and other equipment cleaned before removal from work area?	X		
5. Furniture and other stationary items in work area covered and sealed?	X		
6. Are walls and floors covered and sealed?	X		
7. Are polyethylene film barriers disposed of properly?			N/A at this stage of removal
8. Is waste bagged while wet?	X		
9. Are 6 mil bags used?	X		
0. Are bags properly labeled?	X		
1. Are bags placed in drums and sealed?	X		
2. Are workers wearing protective clothing at all times while in work area?	X		
3. Are workers disposing of contaminated clothing?	X		
4. Are respirators worn at all times?	X		
5. Eating, drinking, smoking, or gum/tobacco chewing in work area?		X	
6. Are workers using the shower?	X		

DISPOSAL	Yes	No	Comments
1. Labels on the drums?	X		
2. Are drums with ruptured bags disposed of properly?			N/A
3. Do disposal personnel obtain trip tickets to verify trips to the landfill?			N/A

INVESTIGATOR'S COMMENTS (Use reverse side of page if necessary) Several electrical hazards were brought to the attention of the contractor including ungrounded work lights and allowing wiring to remain in standing water.

Investigator's Signature: [redacted]

APPENDIX B

INVESTIGATOR'S SURVEY CHECKLISTS

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION
OCCUPATIONAL SAFETY AND HEALTH SERVICES

Investigator's Survey Checklist

Investigator: William Ewing Date: 5/30/82 Time: 1900

Location: CDC, 1600 Clifton Rd., Atlanta, Building 6, Mech Rooms

Project Engineer: Mr. Ron Wallace Phone: (404) 329-3883

Project Administrator: Mrs. Gailya Walter Phone: (404) 329-3883

Contractor Name and Address: Speciality Insulation Services
Atlanta, GA
Phone: (404) 435-0139

WORK AREA OBSERVATIONS	Yes	No	Comments
1. Work area isolated? (note how)	X		
2. All openings to work area sealed?	X		
3. Air movement system sealed off?	X		
4. Negative pressure maintained in work area? How?		X	N/A
5. Warning signs at all entrances/exits?	X		
6. Entrance to work area securable?	X		
7. EPA and OSHA regulations posted on site?	X		
8. Number of workers in area 8			
9. Evidence of medical exams for each worker?			N/A

PERSONAL PROTECTIVE EQUIPMENT			
1. NIOSH approved respirators? Type? MSA Comfo II, twin cartridge	X		
2. Disposable coveralls?	X		
3. Head covering?	X		
4. Foot/shoe covering?	X		

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CHANGE ROOM	Yes	No	Comments
1. Hangers/lockers/bins for street clothes?	X		
2. Lockbox for valuables?			N/A
3. Shower available on-site?	X		
4. Airlock to shower?	X		
5. Sanitary conditions maintained?	X		
6. Airlock to inside change room?	X		
7. Disposal bin for protective equipment?	X		
8. Airlock to work area?	X		

WORK PRACTICES			
1. Are wet methods employed?	X		
2. EPA-recommended wetting agent used?	X		
3. Are HEPA filter vacuums used?			N/A
4. Are light fixtures and other equipment cleaned before removal from work area?	X		
5. Furniture and other stationary items in work area covered and sealed?	X		
6. Are walls and floors covered and sealed?		X	(See notes)
7. Are polyethylene film barriers disposed of properly?			N/A
8. Is waste bagged while wet?	X		
9. Are 6 mil bags used?	X		
10. Are bags properly labeled?	X		
11. Are bags placed in drums and sealed?	X		
12. Are workers wearing protective clothing at all times while in work area?	X		
13. Are workers disposing of contaminated clothing?	X		
14. Are respirators worn at all times?	X		
15. Eating, drinking, smoking, or gum/tobacco chewing in work area?		X	
16. Are workers using the shower?	X		

DISPOSAL	Yes	No	Comments
1. Labels on the drums?	X		
2. Are drums with ruptured bags disposed of properly?			N/A
3. Do disposal personnel obtain trip tickets to verify trips to the landfill?			N/A

INVESTIGATOR'S COMMENTS (Use reverse side of page if necessary) Vacuums not needed at this stage of the project. Floor in boiler room not covered, however openings are sealed. Protective clothing not worn properly. Electrical hazards exist in the work area (ungrounded wiring in standing water), metal ladders with ungrounded wiring (see below)

Investigator's Signature: William M. Ewing

attached. Coverings on stationary items are deteriorating due to high humidity. These items were brought to the attention of the contractor.

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OCCUPATIONAL SAFETY AND HEALTH SERVICES

Investigator's Survey Checklist

Investigator: William M. Ewing Date: 5/31/82 Time: 1600

Location: CDC 1600 clifton Rd. Atlanta, GA.30333 Building #6, Mechanical Room

Project Engineer: Mr. Ron Wallace Phone: (404) 329-3883

Project Administrator: Mrs. Gailya Walter Phone: (404) 329-3883

Contractor Name and Address: Specialty Insulation Services

Atlanta, Georgia

Phone: (404) 435-0139

WORK AREA OBSERVATIONS	Yes	No	Comments
1. Work area isolated? (note how)	X		
2. All openings to work area sealed?	X		
3. Air movement system sealed off?	X		
4. Negative pressure maintained in work area? How?		X	N/A
5. Warning signs at all entrances/exits?	X		
6. Entrance to work area securable?	X		
7. EPA and OSHA regulations posted on site?	X		
8. Number of workers in area 8			
9. Evidence of medical exams for each worker?			N/A

PERSONAL PROTECTIVE EQUIPMENT			
1. NIOSH approved respirators? Type?	X		
2. Disposable coveralls?	X		
3. Head covering?	X		
4. Foot/shoe covering?	X		

CHANGE ROOM	Yes	No	Comments
1. Hangers/lockers/bins for street clothes?	X		
2. Lockbox for valuables?			N/A
3. Shower available on-site?	X		
4. Airlock to shower?	X		
5. Sanitary conditions maintained?	X		
6. Airlock to inside change room?	X		
7. Disposal bin for protective equipment?	X		
8. Airlock to work area?	X		

WORK PRACTICES			
1. Are wet methods employed?	X		
2. EPA-recommended wetting agent used?	X		
3. Are HEPA filter vacuums used?	X		
4. Are light fixtures and other equipment cleaned before removal from work area?	X		
5. Furniture and other stationary items in work area covered and sealed?	X		
6. Are walls and floors covered and sealed?	X		
7. Are polyethylene film barriers disposed of properly?			N/A at this time
8. Is waste bagged while wet?	X		
9. Are 6 mil bags used?	X		
10. Are bags properly labeled?	X		
11. Are bags placed in drums and sealed?	X		
12. Are workers wearing protective clothing at all times while in work area?	X		
13. Are workers disposing of contaminated clothing?	X		
14. Are respirators worn at all times?	X		
15. Eating, drinking, smoking, or gum/tobacco chewing in work area?		X	
16. Are workers using the shower?	X		

DISPOSAL	Yes	No	Comments
1. Labels on the drums?			See Below
2. Are drums with ruptured bags disposed of properly?			N/A
3. Do disposal personnel obtain trip tickets to verify trips to the landfill?			N/A

INVESTIGATOR'S COMMENTS (Use reverse side of page if necessary) Drums are stenciled as containing asbestos; however, this does not conform specifically to the OSHA or EPA required identification. This item was brought to the attention of the contractor.

Investigator's Signature: William M. Sims

Note: All removal and clean up work has been completed. Barriers are still in place and air systems are still shut down.

Investigator's Survey Checklist

Investigator: William M. Ewing Date: 6/2/82 Time: 1420

Location: CDC, 1600 Clifton Road, Atlanta, Ga., Work Area B, Building 2

Project Engineer: Mr. Ron Wallace Phone: (404) 329-3883

Project Administrator: Mrs. Gailya Walter Phone: (404) 329-3883

Contractor Name and Address: Specialty Insulation Services, Inc.
Atlanta, Georgia
Phone: (404) 435-0139

	YES	NO	Comments
RENOVATION/WORK AREA OBSERVATIONS			
1. Work area isolated? (note how)	X		Polyethylene plastic, walls, and doors
2. All openings to work area sealed?	X		
3. Air movement system sealed off?	X		
4. Negative pressure maintained in work area How?		X	N/A
5. Warning signs at all entrances/exits?	X		
6. Entrance to work area securable?	X		
7. EPA and OSHA regulations posted on site?	X		
8. Number of workers in area 6			
PERSONAL PROTECTIVE EQUIPMENT			
1. NIOSH approved respirators? Type? Type C Supplied-air	X		
2. Disposable coveralls?	X		
3. Head covering?	X		
4. Foot/shoe covering?	X		

CHANGE ROOM

1. Hangers/lockers/bins for street clothes?	X		
2. Lockbox for valubles?			N/A
3. Shower available on-site?	X		
4. Airlock to shower?	X		
5. Sanitary conditions maintained?	X		
6. Airlock to inside change room?	X		
7. Disposal bin for protective equipment?	X		
8. Airlock to work area?	X		

WORK PRACTICES

1. Are wet methods employed?	X		(See notes)
2. EPA-recommended wetting agent used?	X		
3. Are HEPA filter vacuums used?			N/A at this point
4. Are light fixtures and other equipment cleaned before removal from work area:	X		
5. Furniture and other stationary items in work area covered and sealed?	X		
6. Are walls and floors covered and sealed?			(See notes)
7. Are polyethylene film barriers disposed of properly?			N/A at this point
8. Is waste bagged while wet?	X		
9. Are 6 mil bags used?	X		
10. Are bags properly labeled?	X		
11. Are bags placed in drums and sealed?	X		
12. Are workers wearing protective clothing at all times while in work area?	X		
13. Are workers disposing of contaminated clothing?	X		

14. Are respirators worn at all times?	X		
15. Eating, drinking, smoking, or gum/tobacco chewing in work area?		X	
16. Are workers using the shower?	X		

DISPOSAL

1. Labels on the drums?		X	
2. Are drums with ruptured bags disposed of properly?			N/A
3. Do disposal personnel obtain trip tickets to verify trips to the landfill?			N/A

INVESTIGATOR'S COMMENTS (Use reverse side of page if necessary) Cement floors in the projection rooms have not been covered since their was not a feasible way to seal them and move the platforms. Walls and floors throughout all other areas have been covered

Investigator's signature: [redacted]

and sealed with 1-3 layers of plastic. Drums, even though reused, should be labeled according to the specifications of OSHA 29 CFR 1910.1001(g)(2) or EPA 40 CFR 61.22(j)(3)(i)(C). Wet methods are being attepted, however saturation of the insulation has not been successful. The insulation has been painted not allowing water (amended) to penetrate the material. Water nozzels equipped with narrow wands for injecting the water into the material has not been successful as tha air sampling data indicate. Accordingly we recommend that the Type C Supplied-air respirators remain in use throughout gross cleanup.

The workers were observed wearing their protective equipment (including clothes and respirators)correctly. All barriers appeared to well sealed when checked with visible smoke.

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION
OCCUPATIONAL SAFETY AND HEALTH SERVICES

Investigator's Survey Checklist

Investigator: Kenneth E. Johnson Date: 6/3/82 Time: 0905

Location: 1600 Clifton Road, CDC, Atlanta, Georgia, Work Area B, Building 2

Project Engineer: Mr. Ron Wallace Phone: (404) 329-3883

Project Administrator: Mrs. Gailya Walter Phone: (404) 329-3883

Contractor Name and Address: Specialty Insulation Services

Atlanta, Georgia

Phone: (404) 435-0139

WORK AREA OBSERVATIONS	Yes	No	Comments
1. Work area isolated? (note how)	X		Plastic film
2. All openings to work area sealed?	X		
3. Air movement system sealed off?	X		
4. Negative pressure maintained in work area? How?		X	N/A
5. Warning signs at all entrances/exits?	X		
6. Entrance to work area securable?	X		
7. EPA and OSHA regulations posted on site?		X	
8. Number of workers in area 6			
9. Evidence of medical exams for each worker?			N/A

PERSONAL PROTECTIVE EQUIPMENT			
1. NIOSH approved respirators? Type? Type C Supplied-Air	X		
2. Disposable coveralls?	X		
3. Head covering?	X		
4. Foot/shoe covering?	X		

CHANGE ROOM	Yes	No	Comments
1. Hangers/lockers/bins for street clothes?	X		
2. Lockbox for valuables?			N/A
3. Shower available on-site?	X		
4. Airlock to shower?	X		
5. Sanitary conditions maintained?	X		
6. Airlock to inside change room?	X		
7. Disposal bin for protective equipment?	X		
8. Airlock to work area?	X		

WORK PRACTICES			
1. Are wet methods employed?	X		
2. EPA-recommended wetting agent used?	X		
3. Are HEPA filter vacuums used?			N/A at this point
4. Are light fixtures and other equipment cleaned before removal from work area?	X		
5. Furniture and other stationary items in work area covered and sealed?	X		
6. Are walls and floors covered and sealed?			See notes of 6/2/82 Checklist
7. Are polyethylene film barriers disposed of properly?			N/A
8. Is waste bagged while wet?	X		
9. Are 6 mil bags used?	X		
0. Are bags properly labeled?	X		
1. Are bags placed in drums and sealed?	X		
2. Are workers wearing protective clothing at all times while in work area?	X		
3. Are workers disposing of contaminated clothing?	X		
4. Are respirators worn at all times?	X		
5. Eating, drinking, smoking, or gum/tobacco chewing in work area?		X	
6. Are workers using the shower?	X		

DISPOSAL	Yes	No	Comments
1. Labels on the drums?		X	
2. Are drums with ruptured bags disposed of properly?			N/A
3. Do disposal personnel obtain trip tickets to verify trips to the landfill?			N/A

INVESTIGATOR'S COMMENTS (Use reverse side of page if necessary) Contractor continues to mprove the enforcement of properly using protective clothing. Water on the floor in the rea of the shower was brought to the attention of the contractor who began wet-vacuuming nd mopping to protect the tile. High humidity has caused the duct tape to pull loose from everal barriers. This was brought to the attention of the contractor and it was repaired nd barriers re-sealed.

Investigator's Signature: [redacted]

GEORGIA INSTITUTE OF TECHNOLOGY
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OCCUPATIONAL SAFETY AND HEALTH SERVICES

Investigator's Survey Checklist

Investigator: William M. Ewing Date: 6/4/82 Time: 0915

Location: CDC, 1600 Clifton Road, Atlanta, Georgia, Work Area B, Building 2

Project Engineer: Mr. Ron Wallace Phone: (404) 329-3883

Project Administrator: Mrs. Gailya Walter Phone: (404) 329-3883

Contractor Name and Address: Specialty Insulation Services, Inc.
Atlanta, Georgia
Phone: (404) 435-0139

WORK AREA OBSERVATIONS	Yes	No	Comments
1. Work area isolated? (note how)	X		Polyethylene plastic
2. All openings to work area sealed?	X		
3. Air movement system sealed off?	X		
4. Negative pressure maintained in work area? How?		X	N/A
5. Warning signs at all entrances/exits?	X		
6. Entrance to work area securable?	X		
7. EPA and OSHA regulations posted on site?	X		
8. Number of workers in area 7			
9. Evidence of medical exams for each worker?			N/A

PERSONAL PROTECTIVE EQUIPMENT			
1. NIOSH approved respirators? Type? Type C Supplied-Air	X		See Notes
2. Disposable coveralls?	X		
3. Head covering?	X		
4. Foot/shoe covering?	X		

CHANGE ROOM	Yes	No	Comments
1. Hangers/lockers/bins for street clothes?	X		
2. Lockbox for valuables?			N/A
3. Shower available on-site?	X		
4. Airlock to shower?	X		
5. Sanitary conditions maintained?	X		
6. Airlock to inside change room?	X		
7. Disposal bin for protective equipment?	X		
8. Airlock to work area?	X		

WORK PRACTICES			
1. Are wet methods employed?	X		See Notes
2. EPA-recommended wetting agent used?	X		
3. Are HEPA filter vacuums used?	X		
4. Are light fixtures and other equipment cleaned before removal from work area?	X		
5. Furniture and other stationary items in work area covered and sealed?	X		
6. Are walls and floors covered and sealed?	X		See notes of 6/2/82
7. Are polyethylene film barriers disposed of properly?	X		
8. Is waste bagged while wet?	X		
9. Are 6 mil bags used?	X		
0. Are bags properly labeled?	X		
1. Are bags placed in drums and sealed?	X		
2. Are workers wearing protective clothing at all times while in work area?	X		
3. Are workers disposing of contaminated clothing?	X		
Are respirators worn at all times?	X		
Eating, drinking, smoking, or gum/tobacco chewing in work area?		X	
Are workers using the shower?	X		

DISPOSAL	Yes	No	Comments
1. Labels on the drums?		X	See notes of 6/3/82
2. Are drums with ruptured bags disposed of properly?			N/A
3. Do disposal personnel obtain trip tickets to verify trips to the landfill?			N/A

INVESTIGATOR'S COMMENTS (Use reverse side of page if necessary) Type C supplied-air is in se by all workers except two who are scraping and cleaning beneath the platforms where air ines pose a hazard because they can become easily caught and pull the mask loose from the ace of the worker. These personnel are wearing twin cartridge MSA Comfo II™ (NIOSH approved) espirators. Since dry brushing of the walls and ceiling is necessary to remove residual ibers water is not being used; however, workers are misting the air in the work area and etting the floor to reduce airborne fibers. There is still a problem with water leaking eneath the three layers of plastic on the floor in the hallway. The contractor is aware f this and continues to attempt to remove as much as possible without detroying the loor barriers.

Investigator's Signature: [redacted]

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OCCUPATIONAL SAFETY AND HEALTH SERVICES

Investigator's Survey Checklist

Investigator: Kenneth E. Johnson Date: 6/6/82 Time: 10:00 AM

Location: CDC, 1600 Clifton Rd. Atlanta, Ga. Work Area B Bldg. 2

Project Engineer: Mr. Ron Wallace Phone: (404) 329-3883

Project Administrator: Mrs. Gailya Walter Phone: (404) 329-3883

Contractor Name and Address: Specialty Insulation Services, Inc.

Atlanta, Georgia

Phone: (404) 435-0139

WORK AREA OBSERVATIONS	Yes	No	Comments
1. Work area isolated? (note how)	x		Polyethylene plastic
2. All openings to work area sealed?	x		
3. Air movement system sealed off?	x		
4. Negative pressure maintained in work area? How?		x	N/A
5. Warning signs at all entrances/exits?	x		
6. Entrance to work area securable?	x		
7. EPA and OSHA regulations posted on site?	x		
8. Number of workers in area 7			
9. Evidence of medical exams for each worker?			N/A

PERSONAL PROTECTIVE EQUIPMENT			
1. NIOSH approved respirators? Type? MSA Comfo II twin Cartridge	x		
2. Disposable coveralls?	x		
3. Head covering?	x		
4. Foot/shoe covering?	x		

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CHANGE ROOM	Yes	No	Comments
1. Hangers/lockers/bins for street clothes?	X		
2. Lockbox for valuables?			N/A
3. Shower available on-site?	X		
4. Airlock to shower?	X		
5. Sanitary conditions maintained?	X		
6. Airlock to inside change room?	X		
7. Disposal bin for protective equipment?	X		
8. Airlock to work area?	X		

WORK PRACTICES			
1. Are wet methods employed?	X		
2. EPA-recommended wetting agent used?	X		
3. Are HEPA filter vacuums used?	X		
4. Are light fixtures and other equipment cleaned before removal from work area?	X		
5. Furniture and other stationary items in work area covered and sealed?	X		
6. Are walls and floors covered and sealed?	X		See notes
7. Are polyethylene film barriers disposed of properly?	X		
8. Is waste bagged while wet?	X		
9. Are 6 mil bags used?	X		
0. Are bags properly labeled?	X		
1. Are bags placed in drums and sealed?	X		
2. Are workers wearing protective clothing at all times while in work area?	X		
3. Are workers disposing of contaminated clothing?	X		
4. Are respirators worn at all times?	X		
5. Eating, drinking, smoking, or gum/tobacco chewing in work area?		X	
6. Are workers using the shower?	X		

DISPOSAL	Yes	No	Comments
1. Labels on the drums?		X	See notes of 6/3/82
2. Are drums with ruptured bags disposed of properly?			N/A
3. Do disposal personnel obtain trip tickets to verify trips to the landfill?			N/A

INVESTIGATOR'S COMMENTS (Use reverse side of page if necessary) Type C supplied air was not in use on this day. This was the final cleanup and it was felt that levels were lower since all removal had been completed. The floors in the hallway had been uncovered to allow the workers to vacuum up water that had leaked beneath the plastic.

Investigator's Signature: [redacted]

All other barriers were still in place and appeared to be in good condition.

GEORGIA INSTITUTE OF TECHNOLOGY
ENGINEERING EXPERIMENT STATION
OCCUPATIONAL SAFETY AND HEALTH SERVICES

Investigator's Survey Checklist

vestigator: Kenneth E. Johnson **Date:** 6/7/82 **Time:** 11:00

:ation: CDC, 1600 Clifton Road, Atlanta, Georgia - Work Area B, Building 2

)ject Engineer: Mr. Ron Wallace **Phone:** (404) 329-3883

)ject Administrator: Mrs. Gailya Walter **Phone:** (404) 329-3883

ıtractor Name and Address: Specialty Insulation Services, Inc.
Atlanta, Georgia
Phone: (404) 435-0139

RK AREA OBSERVATIONS	Yes	No	Comments
Work area isolated? (note how)	X		Polyethylene plastic
All openings to work area sealed?	X		
Air movement system sealed off?	X		
Negative pressure maintained in work area? How?		X	N/A
Warning signs at all entrances/exits?	X		
Entrance to work area securable?	X		
EPA and OSHA regulations posted on site?	X		
Number of workers in area 7			
Evidence of medical exams for each worker?			N/A

RSONAL PROTECTIVE EQUIPMENT			
NIOSH approved respirators? Type? MSA Comfo II	X		
Disposable coveralls?	X		
Head covering?	X		
Foot/shoe covering?	X		

82-015

NGE ROOM	Yes	No	Comments
Hangers/lockers/bins for street clothes?	X		
Lockbox for valuables?			N/A
Shower available on-site?	X		
Airlock to shower?	X		
Sanitary conditions maintained?	X		
Airlock to inside change room?	X		
Disposal bin for protective equipment?	X		
Airlock to work area?	X		

K PRACTICES

Are wet methods employed?	X		
EPA-recommended wetting agent used?	X		
Are HEPA filter vacuums used?	X		
Are light fixtures and other equipment cleaned before removal from work area?	X		
Furniture and other stationary items in work area covered and sealed?	X		
Are walls and floors covered and sealed?	X		See notes of 6/6/82 survey
Are polyethylene film barriers disposed of properly?	X		
Is waste bagged while wet?	X		
Are 6 mil bags used?	X		
Are bags properly labeled?	X		
Are bags placed in drums and sealed?	X		
Are workers wearing protective clothing at all times while in work area?	X		
Are workers disposing of contaminated clothing?	X		
Are respirators worn at all times?	X		
Eating, drinking, smoking, or gum/tobacco chewing in work area?		X	
Are workers using the shower?	X		

SPOSAL	Yes	No	Comments
Labels on the drums?		X	See notes of 6/3/82
Are drums with ruptured bags disposed of properly?			N/A
Do disposal personnel obtain trip tickets to verify trips to the landfill?			N/A

VESTIGATOR'S COMMENTS (Use reverse side of page if necessary) All work has been com-

eted. Final air samples are being collected to determine if fiber count is low enough

r re-entry by CDC personnel.

vestigator's Signature: [redacted]

APPENDIX C

SAMPLING AND ANALYTICAL METHOD

PROCEDURES FOR FIBER COUNTING BY MICROSCOPY

SAMPLE PREPARATION

Preparation of the Mounting Solution

Combine in a one-to-one ratio (by volume) dimethyl phthalate and diethyl oxalate and pour into a Wheaton balsam bottle. The viscosity of the solution must then be adjusted; if the mixture is too "thin" the solution will cause the movement of the fibers on the filter; if it is too "thick" the filters will not dissolve completely. The viscosity is adjusted by adding blank filters to the solution. The number of filters to add is based on the amount of solution prepared; approximately 0.05 $\pm$ 0.005 grams of new membrance filter per milliliter of solution. Use 10 ml each reagent, 1.2 g of MCEF membranes. The resulting solution should appear about as viscous as molasses. The normal shelf life of the solution is about three months. Twenty ml of mounting solution will prepare approximately 300 samples.

Sample Mounting

1. Clean the slides and cover slips with lens tissue. Lay each slide down on a clean surface with the frosted end up. It is a good practice to rest one edge of the cover slip on the slide and the other edge on the working surface. By doing this, you keep the bottom surface (the one which contacts the filter) from becoming contaminated.

2. Wipe all the mounting tools clean with lens tissue and place them on a clean surface (such as lens tissue). All tools should be wiped clean prior to mounting each sample.

3. Using the glass rod supplied with the Wheaton balsam bottle, apply a drop of mounting solution onto the center of the slide. It may be necessary to adjust the quantity of the solution so that after the cover slip has been placed on top, the solution extends only slightly beyond the filter boundry. If the quantity is greater than this particle migration may occur.

4. Using another glass rod, spread the mounting media into a triangular shape. The size of the triangle should coincide with the dimension of the filter wedge.

5. Separate the middle and bottom sections of the cassette to expose the filter. Cut a triangular wedge from the center to the edge of the filter using the scalpel. The size of the wedge should approximate one-eighth of the filter surface. The filter should not be removed from the cassette for cutting.

6. Grasp the filter wedge with the tweezers on the perimeter of the filter which was clamped betwen the cassette sections. DO NOT TOUCH THE FILTER WITH YOUR FINGERS. Place the wedge, SAMPLE SIDE UP, upon the mounting solution.

7. Pick up a clean cover slip with tweezers and carefully place it on the filter wedge. Once contact has been made, DO NOT REPOSITION THE COVER SLIP.

8. Label the slide with the sample number before preceeding to the next filter. On the bottom (backside) of the slide, trace the perimeter of the filter wedge with a felt tip marking pen. This will enable the counter, after the filter has become transparent, to stay within the filter perimeter when counting.

9. The sample should become transparent within about 15 minutes. If the filter appears cloudy, it may be necessary to press VERY LIGHTLY, on the cover slip. This is rarely necessary; however, counting should not be started until an hour after the mounting.

10. Samples should be counted within two days of mounting. Crystals appearing similar to asbestos fibers may begin to grow at the mounting media/air interfaces.

COUNTING OF FIBERS

1. Place the slide on the mechanical stage of the microscope and position the center of the wedge under the objective lens and focus upon the sample. Start counting from one end of the wedge and progress along a radial line to the other end (count in either direction from perimeter to filter tip). Stay away from the filter's edges when counting and sizing. Random fields are selected, without looking into the eyepieces, by slightly advancing the slide in one direction with the mechanical stage control.

2. It is essential to continually scan over a range of focal planes (generally the upper 10 to 15 micrometers of the filter surface) with the fine focus control during each field count. This is especially necessary for asbestos fibers due to their impaction into the filter matrix.

3. On most airborne samples, asbestos fibers will generally have fiber diameters less than one micrometer. Therefore, it is necessary to look carefully for faint fiber images.

4. Regularly check the phase ring alignment.

5. When a mass of material covers a significant portion of the field of view (about one-sixth or greater) reject the field and select another. (Do not include in the number of fields counted.) However, report the fact as it may have meaning on other data collection.

6. Bundles of fibers are counted as one fiber unless both ends of the fiber can be clearly resolved.

7. Count only fibers with a length to width ration greater than or equal to 3:1.

8. Count only fibers greater than 5 micrometers in length. Measure curved fibers along the curve to estimate the total length.

9. Count as many fields as necessary to yield a total count of a least 100 fibers. EXCEPTIONS: a). count at least 20 fields even if you count more than 100 fibers, and b). stop at 100 fields even if you haven't reached 100 fibers.

10. Rules for selecting fibers to be counted: a). COUNT any fiber greater than 5 micrometers in length, that lies entirely within the counting area, b). COUNT as "½ fiber" any fiber with only one end lying within the counting area, and c). DO NOT COUNT any fiber crossing any two sides of the counting area.

CALCULATIONS AND RECORDKEEPING

1. The following data must be recorded in the microscopy data book: a). name of client, b). date of analysis, c). sample number, d). initials of person performing the analysis, e). total number of fibers counted, f). total number of fields counted, g). air volume (if supplied), h). fibers per filter, and i). fibers per cubic centimeter of air (if applicable). Additionally, any comments or notes should be recorded. Also a notation should be made if any deviations from the standard procedure were made.

2. To calculate total fibers per filter:

   fiber/filter = (# of fibers counted/number of fields) (fields/filter)

3. To calculate fibers per cubic centimeter of air:

   fibers/cc = (# of fibers per filter)/((liters of air sampled)(1000))

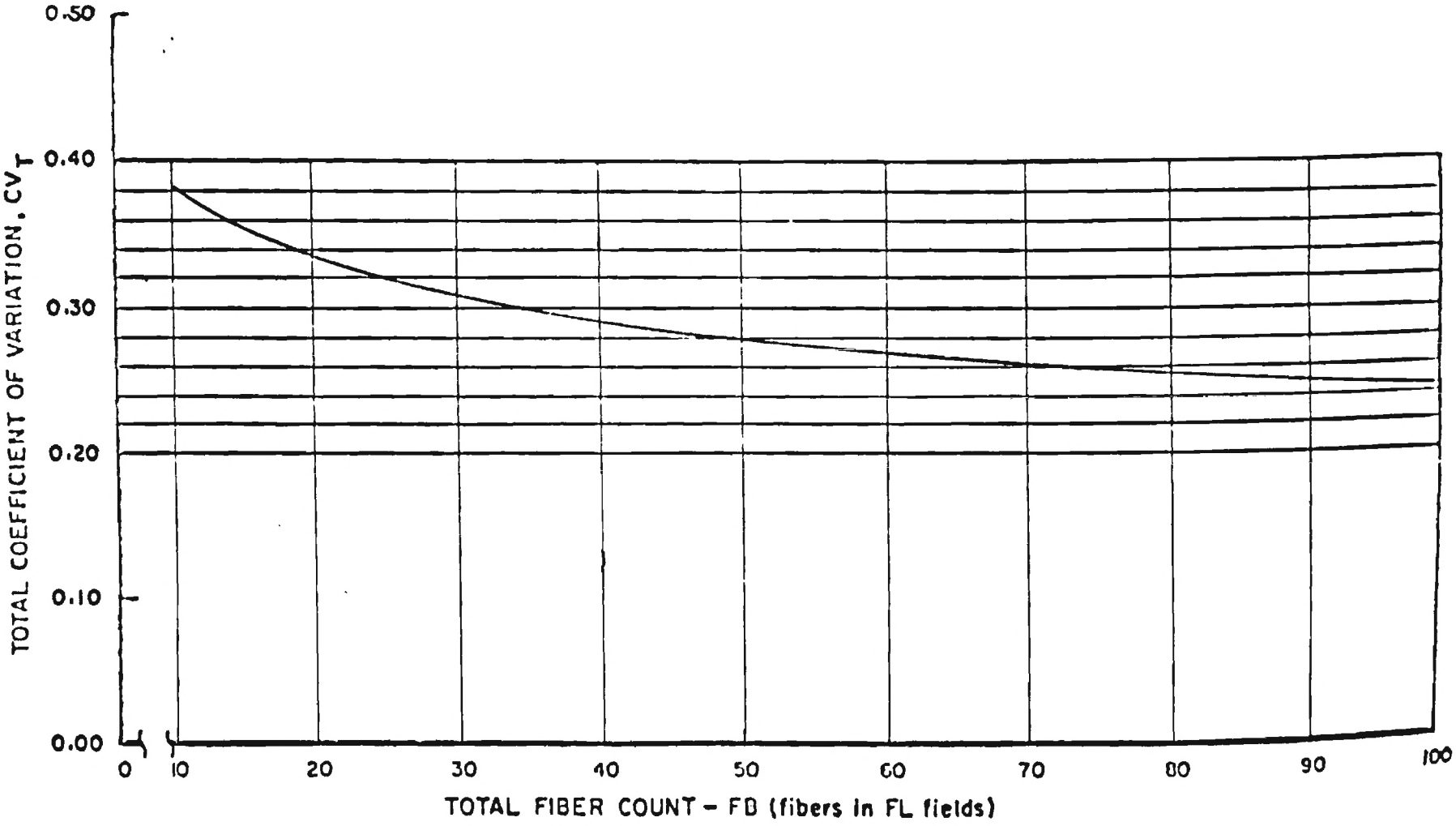
QUALITY CONTROL

1. Approximately one blank should be submitted for every 20 samples.

2. Approximately one filter out of every ten should be selected for recounting. For a pair of counts on the same filter, reject both values because one might be biased if:

   $(FB_2 - FB_1)$ exceeds $2.77\ (\overline{FB})(CV_{\overline{FB}})$

   Where:
   FB_1 = lower fiber count (total fibers)
   FB_2 = higher fiber count (total fibers)
   $\overline{FB}$ = average of the two total fiber counts
   $CV_{\overline{FB}} = CV_T$ for the value FB. Use the relation in figure 1.



Total coefficient of variation as a function of total fiber count

Figure 1.

ASBESTOS FIBERS IN AIR

National Institute for Occupational Safety and Health

Analytical Method

Analyte:	Asbestos fibers	**Method No.:**	P&CAM 239
Matrix:	Air	**Range:**	0.1-60 fibers/cm^3
Procedure:	Filter collection, microscopic count	**Precision (CV_T):**	0.24 to 0.38
Date Issued:	3/30/77	**Classification:**	D (Operational)
Date Revised:			

1. **Principle of the Method**

   1.1 This method describes the equipment and procedures for collecting, mounting, and counting asbestos fibers on cellulose ester membrane filters in the evaluation of personal samples of airborne asbestos fibers. The purpose of the method is to determine an employee's index of exposure to airborne asbestos fibers. The method is primarily a personal monitoring technique, but can be used for area monitoring.

   1.2 The sample is collected by drawing air through a membrane filter by means of a battery powered personal sampling pump. The filter is transformed from an opaque solid membrane to a transparent optically homogeneous gel. The fibers are sized and counted using a phase-contrast microscope at 400-450X magnification.

   1.3 Definitions. Asbestos fiber, for counting purposes, means a particulate which has a physical dimension longer than 5 micrometers and with a length to diameter ratio of 3 to 1 or greater. Asbestos includes chrysotile, cummingtonite-grunerite (amosite), crocidolite, fibrous tremolite, fibrous anthophyllite, and fibrous actinolite.

   1.4 Any laboratory attempting to use this procedure should have at least one counter attend a training course conducted by an experienced, proficient laboratory. Novice, untutored counters, using only published instructions, can easily obtain counts of half those performed by experienced, proficient counters. Large differences between laboratories can be caused by: 1) differences in technique and observing ability among counters and 2) small, but significant, differences between microscopes meeting the basic specifications of Section 6.2. The following procedures are recommended:

      1.4.1 All microscopists who perform asbestos counting should meet together for an "asbestos counting workshop" at least quarterly. This is best accomplished with counters from several laboratories using their own microscopes.

      1.4.2 Each microscopist should count the same series of slides and with the results being compared.

      1.4.3 Differences between counters should be resolved with side-by-side counting of the fields by the different counters.

      1.4.4 Individuals who are found to be persistent outliers over several sessions should be encouraged to seek other tasks in their respective laboratories.

2. Range and Sensitivity

2.1 The usable range is primarily a function of sample volume, microscope count field area, and background airborne particulates. The influence of these variables is discussed in 8.1.3. For a microscope count field area of 0.003 mm^2 (see Figure 1) and a pump flow rate of 1.7 lpm, the optimal fiber densities would be produced over the range of 0.4 fiber/cm^3 (8-hour sample) to about 60 fibers/cm^3 (15-minute sample). For a field area of 0.006 mm^2 (see Figure 2) and a pump flow rate of 1.7 lpm, the optimal range is 0.2 fiber/cm^3 (8-hour sample) to about 30 fibers/cm^3 (15-minute sample). In each case, the optimal detection limits are inversely proportional to pump flow rate.

The upper detection limit can be extended by using sample times less than 15 minutes or using lower flow rates. The lower detection limit can be extended by increasing the flow rate up to about 2.5 lpm. Filter surface fiber densities less than optimal (less than about 0.5 to 1.0 fiber per count field) are still adequate, but will lead to decreased precision for the method (increased coefficient of variation, see Section 4).

The minimum total fiber count in 100 fields considered adequate for reliable quantitation is 10 fibers. Thus, the lower limit of reliable quantitation is 0.1 fiber/cm^3 (100,000 fibers/m^3). For this level, a flow rate of about 2.5 lpm is recommended. For a field area of 0.003 mm^2, the minimum sample time would be about 2 hours. For a field area of 0.006 mm^2, the minimum sample time would be about 1 hour.

2.2 This method considers only fibers with a length to diameter ratio of 3 to 1 or greater and a length greater than 5 micrometers.

3. Interferences

In an atmosphere known to contain asbestos, all particulates with a length to diameter ratio of 3 to 1 or greater, and a length greater than 5 micrometers should, in the absence of other information, be considered to be asbestos fibers and counted as such.

4. Precision and Accuracy

4.1 In the past decade, there have appeared a number of articles examining sources of variation in the asbestos sampling and counting procedure. These include: Lynch et al. (11.1), Weidner and Ayer (11.2), Conway and Holland (11.3), Leidel and Busch (11.4), Beckett and Attfield (11.5), and Rajhans and Bragg (11.6). The sources of variation will be discussed by stages in the membrane filter evaluation procedure.

4.2 **Sources of Variation in the Sampling Process.** These include variations in pump flow rate, proximity of the filter to the employee's body, and filter location (left to right) in the employee's breathing zone.

4.2.1 Section 9.1 requires that the personal sampling pump be calibrated with sufficient accuracy such that the 95% confidence limits on the flow rate are $\pm$ 10%. This is equivalent to a coefficient of variation (CV) of about 5%. However, this CV makes a negligible contribution to the total CV for the method due to the relatively large CV of the counting procedure.

4.2.2 Conway and Holland (11.3) concluded that positioning of the filter cassette on the wearer (regarding the angular portions of the filter and their proximity to the wearer) is not a significant factor in determining the fiber distribution on filters.

4.2.3 Weidner and Ayer (11.2) concluded that there is no appreciable difference between samples collected on either the right or left sides of a breathing zone or between samples collected side-by-side, especially for samples with concentrations less than 2.5 fibers/cm^3.

4.3 Sources of Variation in the Counting Procedure

4.3.1 Random variations exist in the fiber distribution on a filter wedge (intra-wedge variability). The industrial hygiene literature has seen considerable debate in the last 20 years concerning whether or not the distribution of mineral dust or asbestos fibers on a filter surface is adequately described by a Poisson distribution probability density function. Leidel and Busch (11.4) found excellent agreement between empirical error variance and theoretical variance calculated from the assumption of Poisson distributed true counts. They concluded that there was not excessive variation among count fields for a filter wedge and that clumping of fibers (non-random coalescence) did not occur.

4.3.2 Variations exist in the fiber distribution on the total filter surface (inter-wedge variability) due to the random or non-random distribution of fibers across the total surface of the filter. This type of variation is easily confused with intra-wedge variations. The count procedure does not require counting of multiple sectors of the filter. There may be significant differences between average counts for different wedges, or the fiber distribution variations for the total filter surface may be greater than the variations of the Poisson distribution. If either of these occur experimentally, one must use the experimental variations to estimate the minimum precision of the count procedure. The minimum precision is governed by the variations of the fiber distribution on the total surface of the filter.

Conway and Holland (11.3) concluded the distribution of fibers on filters is not uniform and the distribution of fiber counts is more disperse than Poisson. For their filters which had significant variations in fiber concentrations between sectors (as much as 50-60% of the total filter mean), they described the following relation for the standard deviation of the total number of fibers counted on a wedge (N)

$$\text{empirical } s(N) = 1.6\ (N)^{1/2}$$

where N is about 100. The Poisson standard deviation would be:

$$\text{Poisson } \sigma(N) = (N)^{1/2}$$

Rajhans and Bragg (11.6) in Series I of their study found significant variation between filter segments and rejected the Poisson distribution for the total filter surface. However, in Series II of their study, utilizing various experimental modifications, they found no significant variation between filter segments and no reason to reject the assumption of Poisson distributed fiber counts.

4.3.3 Systematic variations due to differences between microscopes were studied by Leidel and Busch (11.4). In their study using five different brands of microscopes, they found no significant differences among four, but the fifth gave counts approximately 45% higher on the average than the other four.

4.3.4 Variations due to differences between counters should be examined at three levels: experienced counters occasionally counting, experienced counters routinely counting, and inexperienced (new or untutored) counters. Leidel and Busch (11.4) studied five experienced counters, with one counting only occasionally. There were no significant differences among three of the counters, but a fourth was 16% lower than the first three. The fifth, who occasionally counted, averaged 27% higher than the first three. Conway and Holland (11.3) studied three experienced counters and three inexperienced counters. They found statistically significant differences between the means of both the experienced and inexperienced counters that typically were in the range plus or minus 5 to 15%. They concluded that experience as a fiber counter is not a significant parameter affecting intercounter variations.

Rajhans and Bragg (11.6) found no significant differences among means of five experienced counters in Series I of their study. But in their carefully controlled Series II, an analysis of variance showed significant variations between counters that were plus or minus 1 to 15%.

4.3.5 Variations between laboratories are most likely due to systematic biases and are not a significant additional source of random variations. Any additional variations are most likely due to differences in counting technique. Beckett and Attfield (11.5) observed that standard counters improved greatly after personal instruction; also new counters, after instruction, tended to overcompensate and get exceedingly high counts. Additionally, they found that counts from an experienced laboratory that had not had contact with other laboratories performing the same analysis were as far from the standard values as were the counts by new counters.

4.4 Sources of variations between samples taken at different times on one employee during one work shift can affect the exposure estimate for that employee. These are primarily due to a) differences in exposure concentrations during the day, b) differences in location of the employee within the plant, and c) differences in work operation performed by the employee during the day. These sources of variation can be controlled by proper choice of sampling strategy. Refer to Leidel and Busch (11.7) and Leidel, Busch, and Lynch (11.8) for an extended discussion of sampling strategies. Interday temporal variations can affect the exposure estimates obtained on different days. Refer to Leidel, Busch, and Crouse (11.9) for a discussion of this type of variation.

4.5 Until recently, the total coefficient of variation (CV_T) for the sampling and counting procedure was best estimated from the work of Conway and Holland (11.3). The conclusions of their study included:

4.5.1 The precision of their procedure for filters not containing an abundance of fine fibers can be estimated by a coefficient of variation of 16.2%. This value includes variation among counters and observed interaction effects.

4.5.2 The accuracy of the procedure for similar filters may be estimated for a 100-fiber count by a coefficient of variation of 21.4%. This assumes that the contribution of the overall variance from the nonuniform fiber distribution is additive.

4.5.3 A high percentage of very fine fibers on the filter can significantly affect the standard deviation and confidence limits for counts by different counters. After combining variations in fiber concentrations over the entire filter with those for different counters, it was concluded:

a. For filters with a low concentration of fine fibers, the coefficient of variation is estimated at 21% and the 95% confidence interval is $\pm$ 43%.

b. For filters with a high concentration of fine fibers, the coefficient of variation is estimated at 25% and the 95% confidence interval is $\pm$ 50%.

Lynch, Kronoveter, and Leidel (11.1) have also reported on variations of the method. Their intralaboratory study utilized the data from a large number of dust counts made by different methods by experienced counters over a period of years in an epidemiologic study of the asbestos products industry. They concluded that the standard deviation of counts of fibers longer than 5 micrometers on membrane filters could be estimated from the relation $\sigma = (N)^{0.591}$. Thus for counts of about 100 fibers, the coefficient of variation could be estimated at about 15.2% and the 95% confidence limits at $\pm$ 30.4%. These values are lower than the values reported by Conway and Holland (11.3).

Recently, the Johns-Manville Corporation conducted an in-house investigation of the asbestos count method (11.10). The study data contained total fiber counts for over

100 filters with each filter counted by two to five counters. From the Johns-Manville data, NIOSH calculated over 100 estimates of the count CV for the method (11.11). The NIOSH CV estimates included random intrafilter variations and intercounter variations, but did not include random pump flow rate variations. It was found that the count coefficient of variation (all random variations except for pump variations) was a function of the total fiber count. NIOSH then included a CV of 0.05 for random pump variations (see Section 9.1) in the CV-estimator equation to obtain a CV_T-estimator. The CV_T-estimator line is plotted on Figure 3 for total fiber counts in the range 10 to 100 fibers. Or the following equation can be used:

$$CV_T = [\text{antilog}_{10}(-0.215 - 0.203\,(\log_{10}FB)) + 0.0025]^2$$

where FB is total fiber count as discussed in Section 10.

Figure 3 demonstrates that for a total fiber count of 100, the best CV_T is attainable with the appropriate sampling times given in 8.1.3 and the count rules in 8.3.9. When making decisions regarding compliance with the OSHA asbestos exposure standards in 29 CFR 1910.1001, the statistical procedures given in Leidel et al. (11.11) should be followed. The procedures are based on statistical theory and assumptions given in References 11.12, 11.13.

Because of the possibility of systematic biases due to differences between microscopes, counters, and laboratories as discussed above, it is strongly recommended that any laboratory counting asbestos should participate in an interlaboratory quality control program that includes the counting of standard reference filters. These standard filters are available from NIOSH through the Proficiency Analytical Testing (PAT) Program. The PAT Program is used by the American Industrial Hygiene Association (AIHA) as part of its Laboratory Accreditation Program. Each laboratory's quality control program must include protocols for routinely adjusting and calibrating sampling and counting equipment plus training and evaluation programs for counters.

5. **Advantages and Disadvantages of the Method**

   5.1 The method is intended to give an index of employee exposure to airborne asbestos fibers of specified dimensional characteristics.

   5.2 It is not meant to count all asbestos fibers in all size ranges or to differentiate asbestos from other fibrous particulates.

6. **Apparatus**

   6.1 Sampling Equipment

   The personal sampling equipment train consists of 1) personal sampling pump, 2) tubing, 3) clothing spring clip, 4) tubing-to-field monitor metal adaptor, and 5) field monitor (filter and holder).

   6.1.1 Personal Sampling Pump. The pump must be capable of sampling at 1.0 to 2.5 liters per minute (lpm) against a flow resistance of 7.5 inches of water (1.4 cm Hg) for 8 continuous hours on a fully charged battery.

   6.1.2 Tubing. Laboratory tubing such as rubber or plastic with 6-mm bore and about 100 cm length.

   6.1.3 Clothing Spring Clip. The clip attaches the rubber tubing to the lapel or shirt of the individual being monitored.

   6.1.4 Tubing-to-field Monitor Adaptor. A short metal adaptor with ridges on one end to grip the inside of the tubing. The other end is designed for a pressure fit into the field monitor.

   6.1.5 Field Monitor (Filter and Holder). The only field monitor currently considered acceptable by NIOSH is manufactured by the Millipore Corporation. The unit con-

sists of 1) a three section styrene plastic case designated Millipore Aerosol Monitor Case, 2) a 37-mm diameter plain white cellulose ester membrane filter designated Millipore AA (pore size of 0.8 micrometer), 3) a support pad, and 4) two plastic sealing caps. If a large number of samples are to be taken, it may be less expensive to reuse the plastic cases. Great care must be taken in the cleaning and reassembly process. The outside mating surfaces of the field monitors may be covered with a "shrink-fit" band to provide proper sealing and a writing surface for filter identification.

6.2 Optical Equipment and Microscope Features

6.2.1 Microscope body with binocular head.

6.2.2 10X Huygenian eyepieces are recommended. Other eyepieces can be substituted if necessary. Wide field eyepieces can be used; however, wide field eyepieces may yield a count field area less than 0.003 mm^2 with the Porton reticle. This is not always desirable from the standpoint of obtaining optimum sampling times (see Section 8.1.3). If wide field eyepieces are used, it is preferable to use the Patterson Globe and Circle reticle to obtain a larger count field area.

6.2.3 Koehler illumination (preferably built-in with provisions for adjusting light intensity).

6.2.4 A Porton reticle is recommended. Others such as the Patterson Globe and Circle can be substituted.

6.2.5 Mechanical stage.

6.2.6 Phase-Contrast condenser with a numerical aperture (N.A.) equal to or greater than the N.A. of the objective.

6.2.7 40-45X phase contrast achromatic objective (N.A. 0.65 to 0.75).

6.2.8 Phase-ring centering telescope or Bertrand lens.

6.2.9 Green or blue filter, if recommended by microscope manufacturer.

6.2.10 Stage micrometer with 0.01 mm subdivisions.

6.2.11 For general guidance on phase contrast microscopy, consult Needham (11.12), Clark (11.15) and McCrone (11.14).

6.3 Filter Mounting Equipment. Experience has shown that certain equipment is useful for efficient sample mounting. The following items are recommended for extracting and mounting a portion of the filter for counting.

6.3.1 Microscope slides. 2.5 by 7.5 cm glass slides are most commonly used. Sample number, data, initials, etc., can be conveniently written on a frosted end slide.

6.3.2 Cover Slips. Cover slips are a necessary part of the slide mount and optical system. The shape should be appropriate for the size of the filter wedge. The appropriate cover slip depends upon the objective to be used. Ordinarily, objectives are optically corrected for a #1½ (0.17 millimeter) thickness cover slip. Improper cover glass thickness will detract from the final image quality.

6.3.3 Scalpel. A scalpel is needed to cut out a portion of the filter to be examined. A number-ten curved blade scalpel is recommended.

6.3.4 Tweezers. A pair of fine-tipped tweezers is used to remove the membrane filter slice from the field monitor and place it upon the slide.

6.3.5 Lens Tissue. To insure cleanliness, a lint-free tissue is recommended. This tissue should also be used for wiping mounting tools and for cleaning slides and cover slips.

6.3.6 Glass Rod. A fire-polished glass rod may be used to spread the mounting solution on the slide.

6.3.7 Wheaton Balsam Bottle. This special glass container has a glass top which prevents contamination of the mounting solution. A glass rod is included for dispensing the solution.

7. Reagents

Chemicals should be reagent grade, free from particles and color, conforming to the specifications of the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available.

7.1 Dimethyl phthalate

7.2 Diethyl oxalate

Avoid getting the mounting solution on the skin. Wash skin promptly with soap and water if skin contact occurs.

8. Procedure

8.1 Sampling

8.1.1 General Information

Guidelines for the monitoring of employee exposures to industrial atmospheres are given in Reference 11.8. The Federal requirements for monitoring employee exposure to airborne asbestos are found in 29 CFR 1910.1001.

8.1.2 Mounting the Sampling Pump on the Worker

Fasten the sampling pump to the worker's belt and fasten the field monitor to the lapel or shirt front (as close to the breathing zone as is practical). Remove the top cover of the plastic monitor, then invert the monitor making certain the exposed filter is facing downward. Turn the pump on and adjust to the calibrated flow rate (1.0 to 2.5 lpm). Record the following information in a logbook.

1. Filter number
2. Pump start time and date
3. Flow rate
4. Subject's name and job title
5. Type of operation or process
6. Ventilation controls and is the worker wearing a respirator approved for asbestos?

The pump should be checked periodically during the sampling period for proper operation and flow rate.

8.1.3 Optimum Sampling Times

The requirement for the minimum count of 100 fibers or 20 fields in 8.3.9 was determined to be the best compromise to achieve adequate precision for the airborne fiber estimate and reasonable counting times. An optimum fiber density of about 1 to 5 fibers per microscope count field is recommended. To estimate appropriate sampling times for feasible counting and optimal counting, one must consider the following constraints:

1. microscope count field area (generally 0.003 to 0.006 mm^2)
2. pump flow rate (typically 2.5 lpm maximum)
3. average airborne fiber concentrations
4. counting rule range of 20 to 100 fields
5. adequate fiber density to obtain a minimum count of 10 fibers in 100 fields, which is the least total fiber count that yields an acceptable count precision
6. background airborne particulate levels that can reduce the count precision due to an obscuring of fibers on the filter surface

The preceding constraints were considered in drawing Figures 1 and 2. These figures were developed from the following relationship:

$$\text{sampling time} = \frac{(FB/FL)\,(ECA/MFA)}{(FR)\,(AC)\,(1000)} \quad \text{minutes}$$

where:

FB/FL = 1 to 5 fibers/field

ECA = effective collecting area of filters (855 mm² for 37-mm filter with effective diameter of 33 mm)

MFA = microscope field area (generally 0.003 to 0.006 mm²)

FR = Pump flow rate (generally 1.0 to 2.5 lpm)

AC = Air concentration of fibers in fibers/cm³.

Figure 1 (microscope field area = 0.003 mm²) and Figure 2 (microscope field area = 0.006 mm²) show optimum and feasible sampling times for a pump flow rate of 1.7 lpm. Each individual responsible for sampling asbestos should prepare a similar chart for his particular pump flow rate and microscope field area before sampling is performed to aid in estimating proper sampling times. On Figures 1 and 2, the areas with solid shading lines are generally the optimum conditions for counting. The broken shading lines are for conditions very close to optimal.

However, feasible counting conditions may extend down to about 0.1 fiber/field and and above 5 fibers/field. Recommended sampling times are most strongly influenced by background airborne particulate levels, once all the other constraints have been estimated. For heavy particulate levels, it may be necessary to limit each filter to about 60 to 180 minutes sampling duration. Each individual responsible for sampling should work closely with the microscopist to attain as high as possible filter surface fiber densities (up to about 5 fibers/field), while avoiding filter surface background particulate levels that create very difficult or impossible counting conditions. If one has very little idea of airborne fiber and particulate levels, the best procedure is to take several long samples (as one 8-hour or two consecutive 4-hour samples) in conjunction with several short samples (as four consecutive 2-hour or eight consecutive 1-hour samples). If the longer samples prove very difficult to count, the microscopist will have the shorter samples to fall back on.

From Figures 1 and 2, it can be seen that there are certain sampling times which will yield optimum fiber densities on the filter for almost all airborne fiber concentrations from 1 to 10 fibers/cm³. These optimum times have been calculated and are presented in Figure 4. Note that the optimum times given by Figure 4 are approximate and can be varied by as much as ± 25%. The nomogram is intended as a guide to be used where no prior knowledge of the air concentration is available.

8.1.4 End of Sampling Period

Remove the field monitor, replace the plastic top cover and the small end caps, and store the monitor. Always shut off the pump when changing monitors to avoid contaminating or damaging the pump. Record the pump shutoff time and flow rate in the logbook.

8.1.5 Blanks

With each batch (25 to 50 filters) of samples sent for analysis, submit two unopened field monitors which have been subjected to the same treatment as the samples except that they were not exposed to the sampling environment. Label these as blanks. If the blanks yield fiber counts greater than 5 fibers/100 fields, then the entire sampling procedure should be examined carefully for the cause of contamination. The

mounting solution of Section 8.2.1 should also be examined for contamination and/or crystal growth.

8.1.6 Shipping

The field monitors in which the samples are collected should be shipped in a rigid container with sufficient packing material to prevent crushing.

8.1.7 Numbers of Samples

When sampling for the Federal ceiling standard of 10 fibers (>5μm)/cm^3, [29 CFR 1910.1001(b) (3), effective July 7, 1972], only one sample (15 minutes maximum duration) is necessary, theoretically. However, several samples should be taken during expected periods of peak air concentrations to allow for detection of gross sampling or counting errors.

When sampling for determination of noncompliance with the Federal 8-hour TWA standard of 2 fibers (>5μm)/cm^3, [29 CFR 1910.1001(b) (2)], one should continuously sample as large a portion of the work day as is feasible for airborne concentrations of about 2 to 10 fibers/cm^3. However, for a lower airborne concentration such as 0.5 fiber/cm^3, one sample might require 4 to 8 hours sampling time in order to get the proper filter fiber density (Section 8.1.3). For this situation, the 8-hour TWA exposure would be determined from one 8-hour or two 4-hour samples as appropriate.

8.2 Sample Preparation

8.2.1 Preparation of Mounting Solution

A very important part of the sample evaluation is the mounting process. This process involves a special mounting medium of prescribed viscosity. The proper viscosity is important in order to expedite filter dissolving and still minimize particle migration. After the sample has been mounted, an elapsed time of approximately sixty minutes is needed before the sample is ready for evaluation.

Combine the dimethyl phthalate and diethyl oxalate in a one to one ratio by volume and pour into a Wheaton balsam bottle. Add approximately 0.05 ($\pm$ 0.005) grams of new membrane filter per milliliter of solution to reach the necessary viscosity. The mixture must be stirred periodically until the filters have dissolved and a homogeneous mixture is formed. The normal shelf life of the mounting solution is about three months. Twenty milliliters of mounting solution will prepare approximately 300 samples.

8.2.2 Sample Mounting

Cleanliness is important! A dirty working area may result in sample contamination and erroneous counts. The following steps should be followed when mounting a sample.

1. Clean the slides and cover slips with lens tissue. Lay each slide down on a clean surface with the frosted end up. It is a good practice to rest one edge of the cover slip on the slide and the other edge on the working surface. By doing this, you keep the bottom surface (the one which contacts the filter) from becoming contaminated.
2. Wipe all the mounting tools clean with lens tissue and place them on a clean surface (such as lens tissue). All tools should be wiped clean prior to mounting each sample.
3. Using the glass rod supplied with the Wheaton balsam bottle, apply a drop of mounting solution onto the center of the slide. It may be necessary to adjust the quantity of solution so that after the cover slip has been placed on top, the solution extends only slightly beyond the filter boundary. If the quantity is greater than this, particle migration may occur.

4. Using another glass rod, spread the mounting media into a triangular shape. The size of this triangle should coincide with the dimension of the filter wedge.
5. Separate the middle and bottom sections of the field monitor case to expose the filter. Cut a triangular wedge from the center to the edge of the filter using the scalpel. The size of the wedge should approximate one-eighth of the filter surface. The filter can be very carefully removed from the cassette for cutting, but this should only be done with great care.
6. Grasp the filter wedge with the tweezers on the perimeter of the filter which was clamped between the monitor case sections. Do not touch the filter with your fingers. Place the wedge, sample side up, upon the mounting medium.
7. Pick up a clean cover slip with tweezers and carefully place it on the filter wedge. Once this contact has been made, do not reposition the cover slip.
8. Label the slide with the sample number and current date before proceeding to the next filter. On the bottom (backside) of the slide, trace the perimeter of the filter wedge with a felt tip marking pen. This will enable the counter, after the filter has become transparent, to stay within the filter perimeter when counting.
9. The sample should become transparent within fifteen minutes. If the filter appears cloudy, it may be necessary to press very lightly on the cover slip. This is rarely necessary; however, counting should not be started until an hour after the mounting. This allows the microscopic texture of the filter to become invisible to microscope viewing.
10. Discard the sample mount after two days if it has not been counted. Crystals appearing similar to asbestos fibers may begin to grow at the mounting media/air interfaces. They seldom present any problems if the slide is examined before two days. In any case, stay away from the filter's edges when counting and sizing.

8.3 Counting of Fibers

8.3.1 Place the slide on the mechanical stage of the microscope and position the center of the wedge under the objective lens and focus upon the sample. Start counting from one end of the wedge and progress along a radial line to the other end (count in either direction from perimeter to wedge tip). Random fields are selected, without looking into the eyepieces, by slightly advancing the slide in one direction with the mechanical stage control.

8.3.2 It is essential to continually scan over a range of focal planes (generally the upper 10 to 15 micrometers of the filter surface) with the fine focus control during each field count. This is especially necessary for asbestos fibers due to their impaction into the filter matrix.

8.3.3 On most airborne samples, asbestos fibers will generally have fiber diameters less than one micrometer. Therefore, it is necessary to look carefully for faint fiber images.

8.3.4 Regularly check phase ring alignment.

8.3.5 When an agglomerate (mass of material) covers a significant portion of the field of view (approx 1/6 or greater) reject the field and select another. (Do not include it in the number of fields counted.) However, report the fact as it may have meaning on other data collection.

8.3.6 Bundles of fibers are counted as one fiber unless both ends of the fiber can be clearly resolved.

8.3.7 Count only fibers with a length to width ratio greater than or equal to 3:1.

8.3.8 Count only fibers greater than 5 micrometers in length. (Be as accurate as possible in accepting fibers near this length.) Measure curved fibers along the curve to estimate the total length.

8.3.9 Count as many fields as necessary to yield a total count of at least 100 fibers. Exceptions: a) count at least 20 fields even if you count more than 100 fibers, and b) stop at 100 fields even if you haven't reached 100 fibers.

8.3.10 For fibers that cross either one or two sides of the counting field, the following procedure is used to obtain a representative count.
COUNT any fiber greater than 5 micrometers in length, that lies entirely within the counting area. COUNT as "½ fiber" any fiber with only one end lying within the counting area. DO NOT COUNT any fiber crossing any two sides.
Reject and do not count all other fibers. Refer to Figures 5 through 10. Note that the fibers in Figures 5 through 10 are not representative of the appearance of most asbestos fibers. Most fibers have a very faint image.

9. Calibration and Standards

9.1 Sampling Train Calibration

The accurate calibration of the sampling pump is essential to the correct calculation of the air volume sampled. The frequency of calibration is dependent on the use, care, and handling to which the pump is subjected. Pumps must be recalibrated if they have just been repaired, misused, or received from the manufacturer. If the pump receives hard usage, more frequent calibration may be necessary. Ordinarily, pumps should be calibrated in the laboratory both before they are used in the field and after they have been used to collect a large number of field samples.

The accuracy of calibration is dependent upon the type of instrument used as a reference. The choice of a calibration instrument will depend largely on where the calibration is performed. For laboratory testing, a 1-liter buret used as a soap bubble flow meter or wet-test meter is recommended. Other standard calibrating instruments, such as a spirometer, Marriott's bottle, or dry gas meter can be used. The calibration should be of sufficient precision that the 95% confidence limits on the flow rate are ± 10% (95% of the flow rates will fall within ± 10% of the calibrated value).

Instructions for calibration with the soap bubble flow meter follow. The sampling train used (pump, hose, filter cassette) in the pump calibration should be the same as the one used in the field.

9.1.1 Check the voltage of the pump battery with a voltmeter both with the pump off and while it is operating to assure adequate voltage for calibration. If necessary, charge the battery to manufacturer's specifications.

9.1.2 Fill a beaker with 10 ml of soap solution.

9.1.3 Connect the filter cassette inlet to the top of the buret with a length of hose.

9.1.4 Turn the pump on and moisten the inside of the soap bubble meter by immersing the open end of the buret into the soap solution and drawing bubbles up the inside of the buret. Perform this task until the bubbles are able to travel the entire length of the buret without breaking.

9.1.5 Adjust the pump rotameter to provide a flow between 1.5 to 2.5 lpm.

9.1.6 With a water manometer, check that the pressure drop across the filter is less than 13 inches of water (about 1 inch of mercury).

9.1.7 Start a soap bubble up the buret and measure the time it takes for the bubble to travel a minimum volume of 1 liter.

9.1.8 Repeat the procedure in 9.1.7 at least three times, average the results, and calculate the calibrated flow rate by dividing the volume traveled by the soap bubble by the elapsed time. If the range between the highest and lowest of the three flow rates is greater than about 0.33 lpm, then the calibration should be repeated since it is likely that the precision is not adequate.

9.1.9 Data required for the calibration include the volume measured, elapsed time, pressure drop, air temperature, atmospheric pressure (or elevation), pump serial number, date, and name of person performing the calibration.

9.1.10 Corrections to the flow rate for pumps with rotameters may be necessary if the pressure (elevation) or temperature where the samples are collected (actual flow rate) differs significantly from that where the calibration was performed (indicated flow rate). Actual flow rates at time of sampling may be calculated for a linear scale rotameter by using the following correction formula:

$$Q_{actual} = Q_{indicated} \sqrt{\frac{P_{cal}}{P_{actual}} \cdot \frac{T_{actual}}{T_{cal}}}$$

where both pressure (P) and temperature (T) are in absolute units such as:

psia = psig + 14.7
deg Rankin = deg Fahrenheit + 460
deg Kelvin = deg Celsius + 273

9.2 Microscope Setup

9.2.1 Porton Reticle and the Counting Field

The asbestos fiber count procedure consists of comparing fiber length to the diameters of calibrated circles of a Porton reticle, and counting all fibers greater than 5 micrometers in length lying within a given counting field area. The Porton reticle is a glass plate inscribed with a series of circles and rectangles. The left half of the reticle is divided into six rectangles constituting the counting field. The counting field is illustrated in Figures 5 through 10.

9.2.2 Placement in Eyepiece

The Porton reticle is placed inside the Huygenian eyepiece where it rests on the field-limiting diaphragm. If other types of eyepieces are used, it may be necessary to insert a counting collar for retaining the reticle. The reticle should always be kept clean, since dirt on the reticle is in focus and could complicate the counting and sizing process.

9.2.3 Stage Micrometer

The Porton reticle cannot be used for counting until it has been properly calibrated with a stage micrometer. Most stage micrometer scales are approximately two millimeters long and are divided into units of one-hundredth of a millimeter (ten micrometers).

9.2.4 Microscope Adjustment

When adjusting the microscope, follow the manufacturer's instructions while observing the following guidelines.

1. The light source image must be in focus and centered on the condenser iris or annular diaphragm.
2. The particulate material to be examined must be in focus.
3. The illuminator field iris must be in focus, centered on the sample, and opened only to the point where the field of view is illuminated.
4. The phase rings (annular diaphragm and phase-shifting elements) must be concentric.

9.2.5 Porton Reticle Calibration Procedure

Each eyepiece-objective-reticle combination on the microscope must be calibrated. Should any of the three be changed (disassembly, replacement, zoom adjustment, etc.), the combination must be recalibrated. Calibration may change if interpupillary dis-

tance is changed. For proper calibration, the following procedure should be followed closely.

With a 10X objective in place, place the stage micrometer on the mechanical stage, focus the millimeter scale, and center the image. Change to the 40–45X objective and adjust the first millimeter scale division to coincide with the left boundary of the Porton rectangle. Measure the distance between the left and extreme right boundaries of the Porton rectangle, estimating any portion of the final division. This measurement represents 200 L units. The rectangle is 100 L units on the short vertical dimension. The calculated "L" is inserted into the formula $D = L(2^N)^{1/2}$ where "N" is the circle number (indicated on the reticle) and "D" is the circle diameter. Since the circle diameters vary logarithmically, every other circle doubles in diameter. For example, circle number three is twice the diameter of number one; number four is twice the diameter of number two. When the circle sizes have been determined, the counting field area which consists of the left six smaller rectangles can be calculated from the relation 10,000 L^2. This completes the reticle calibration for this specific objective-eyepiece-reticle combination.

Example for Porton Reticle

The following calibration was obtained for a pair of 10X Huygenian eyepieces and a 43X objective:

200 L = 0.148 mm = 148 micrometers

100 L = 0.074 mm = 74 micrometers

One L-unit = 0.74 micrometers

Thus Circle #1 has a diameter $D = L(2^N)^{1/2} = 0.74(2^1)^{1/2} = 0.74 \quad (1.414) = 1.05$ micrometers.

Then our circle diameter calibration table looks like:

Diameter of Circle #1 = 1.05 micrometers
#2 = 1.48
#3 = 2.09
#4 = 2.96
#5 = 4.19
#6 = 5.92

Field area = (10,000) (L^2) = (100 L) (100 L) = (0.074) (0.074) = 0.0055 mm^2

Thus fibers with a length greater than a distance halfway between the diameters of the #5 and #6 circles would be counted.

If a Patterson Globe and Circle reticle is used, a different calculation procedure is required. The circle diameters are related as follows. The #25 circle diameter is (0.1) (reticle length).

The circle diameters are proportional to the ratio of their numbers. Thus the #20 circle diameter is (20/25) or 0.8 times the #25 circle diameter.

10. Calculations

10.1 The average airborne asbestos fiber concentration estimated by the filter sample may be calculated from the following formula:

$$AC = \frac{[(FB/FL) - (BFB/BFL)]\ (ECA)}{(1000)\ (FR)\ (T)\ (MFA)}$$

where:

AC = Airborne fiber concentration in (fibers > 5 μm)/cm^3.
BFB = Total number of fibers counted in the BFL fields of the blank or control filters in fibers > 5 μm.
BFL = Total number of fields counted on the blank or control filters.
ECA = Effective collecting area of filter (855 mm^2 for a 37-mm filter with effective diameter of 33 mm).
FR = Pump flow rate in liters/min (lpm).
FB = Total number of fibers counted in the FL fields in fibers > 5 μm.
FL = Total number of fields counted on the filter.
MFA = Microscope count field area in mm^2 (generally 0.003 to 0.006).
T = Sample collection time in minutes.

10.2 Recount criteria. It is very desirable for a counter to conduct a "blind recount" for about 1 in every 10 filter wedges (slides) counted. Alternatively, a second counter could perform the blind recount. In training sessions for novice counters, the trainee should conduct a blind recount for filter wedges counted by an experienced, proficient counter. In all cases, we will observe differences between the first and second counts of the same filter wedge. Most of these differences will be due to chance alone, that is, due to the random variability (precision) of the count method. Statistical recount criteria enable us to decide whether observed differences can reasonably be explained due to chance alone or are probably due to systematic differences between counters or microscopes or due to some other biasing factor.
The following recount criterion is for a pair of counts that estimate some airborne fiber concentration (AC) in fibers/cm^3. The criterion is given at the type-I error level. That is, there is a 5% maximum risk that we will reject a pair of counts for the reason that one might be biased, when the large observed difference is really due to chance.
Reject a pair of counts because one might be biased if:

$$(AC_2 - AC_1) \text{ exceeds } 2.77(\overline{AC})(CV_{FB})$$

where:

AC_1 = lower estimated airborne fiber concentration
AC_2 = higher estimated airborne fiber concentration
$\overline{AC}$ = average of the two airborne concentration estimates
CV_{FB} = average CV for the two concentration estimates which are a function of the total fiber count (FB) in each case. Use the relation in Section 4 or Figure 3.

For a pair of counts on the same filter, reject the pair because one might be biased if:

$$(FB_2 - FB_1) \text{ exceeds } 2.77(\overline{FB})(CV_{\overline{FB}})$$

where:

FB_1 = lower fiber count on the filter (total fibers)
FB_2 = higher fiber count on the filter (total fibers)
$\overline{FB}$ = average of the two total fiber counts
$CV_{\overline{FB}} = CV_T$ for the value FB. Use the relation in Section 4 or Figure 3.

11. References

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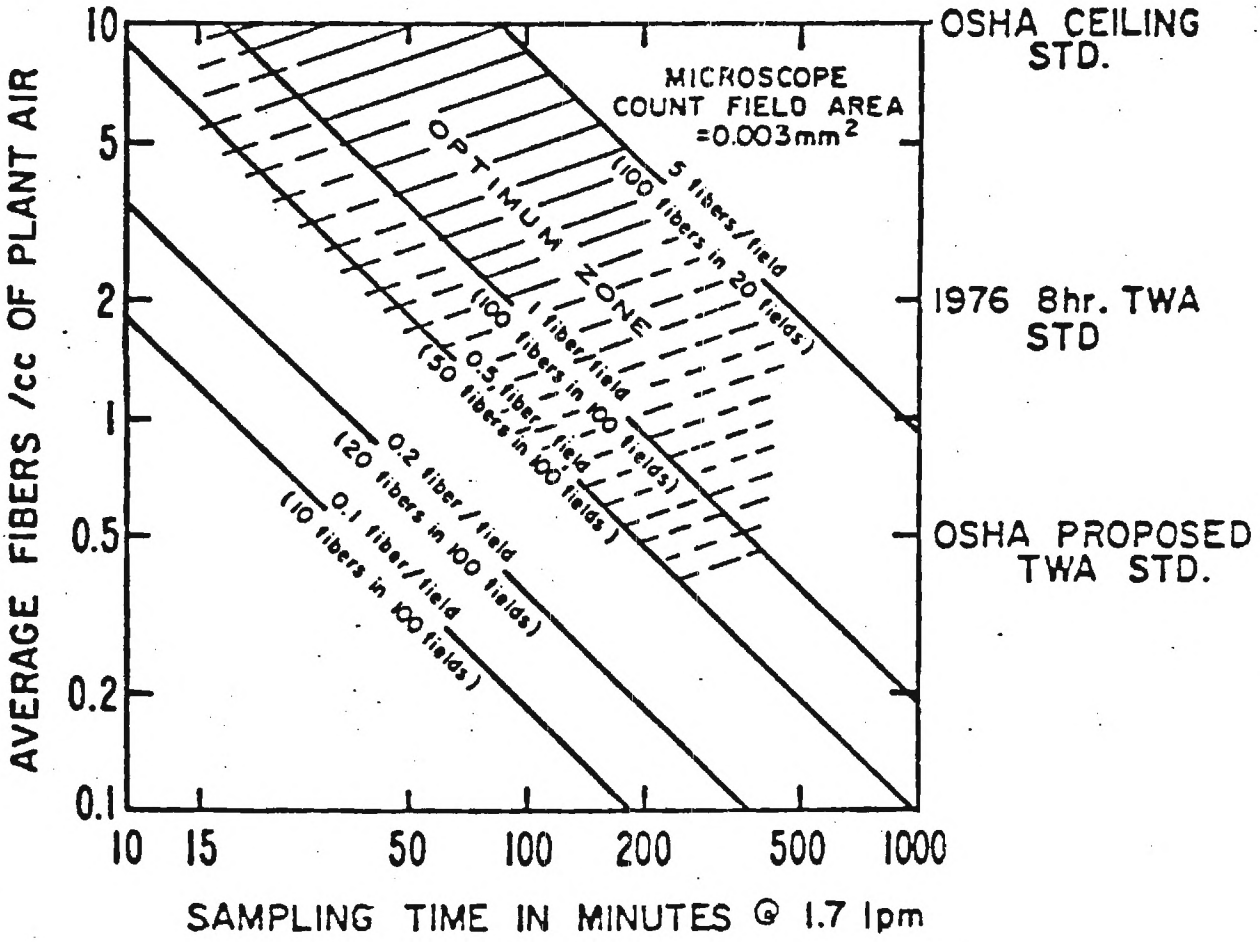

FIGURE 1. Optimum Sampling Times for airborne asbestos where microscopic field area = 0.003 mm²

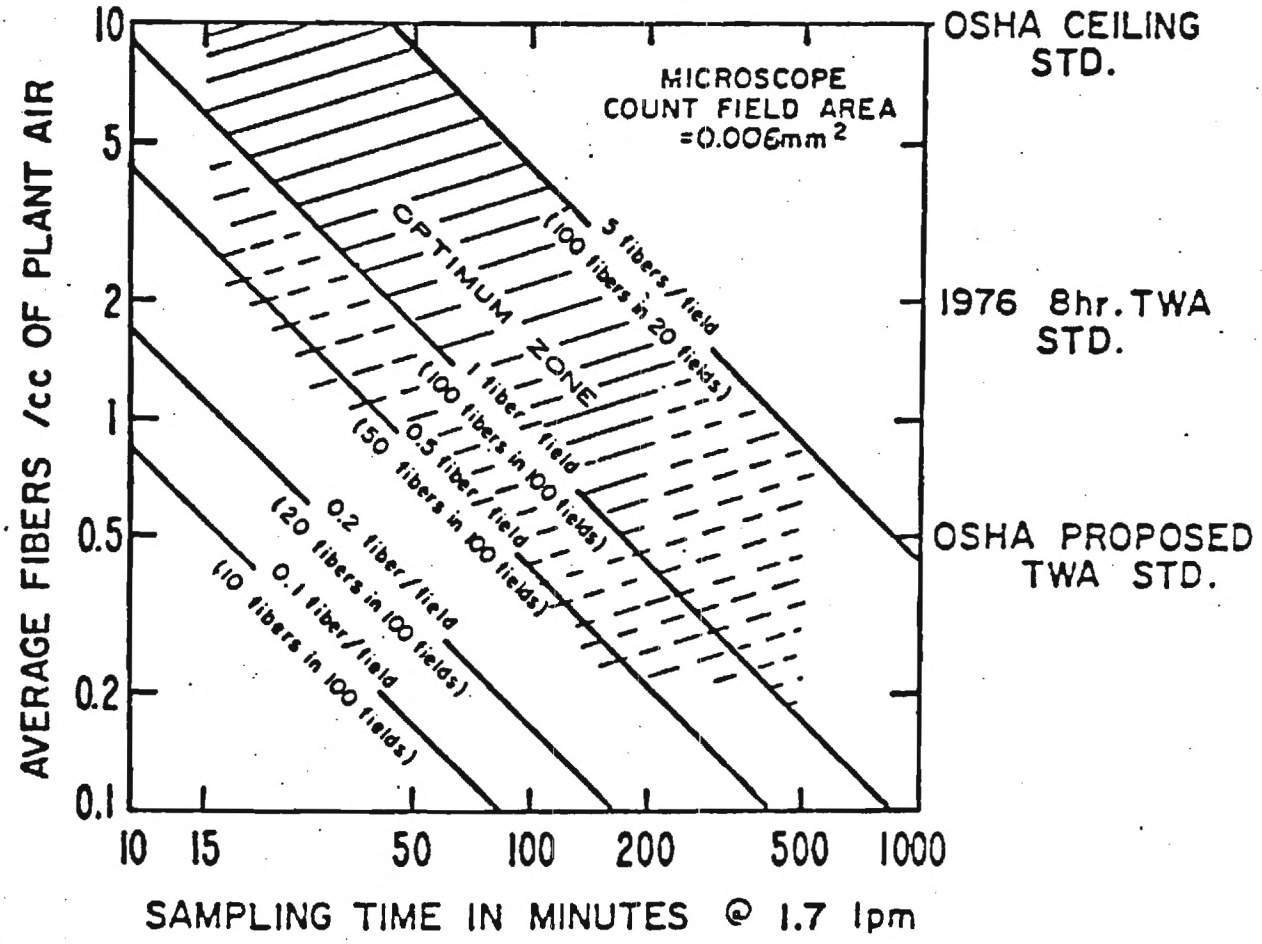

FIGURE 2. Optimum sampling times for airborne asbestos where microscopic field area = 0.006 mm^2

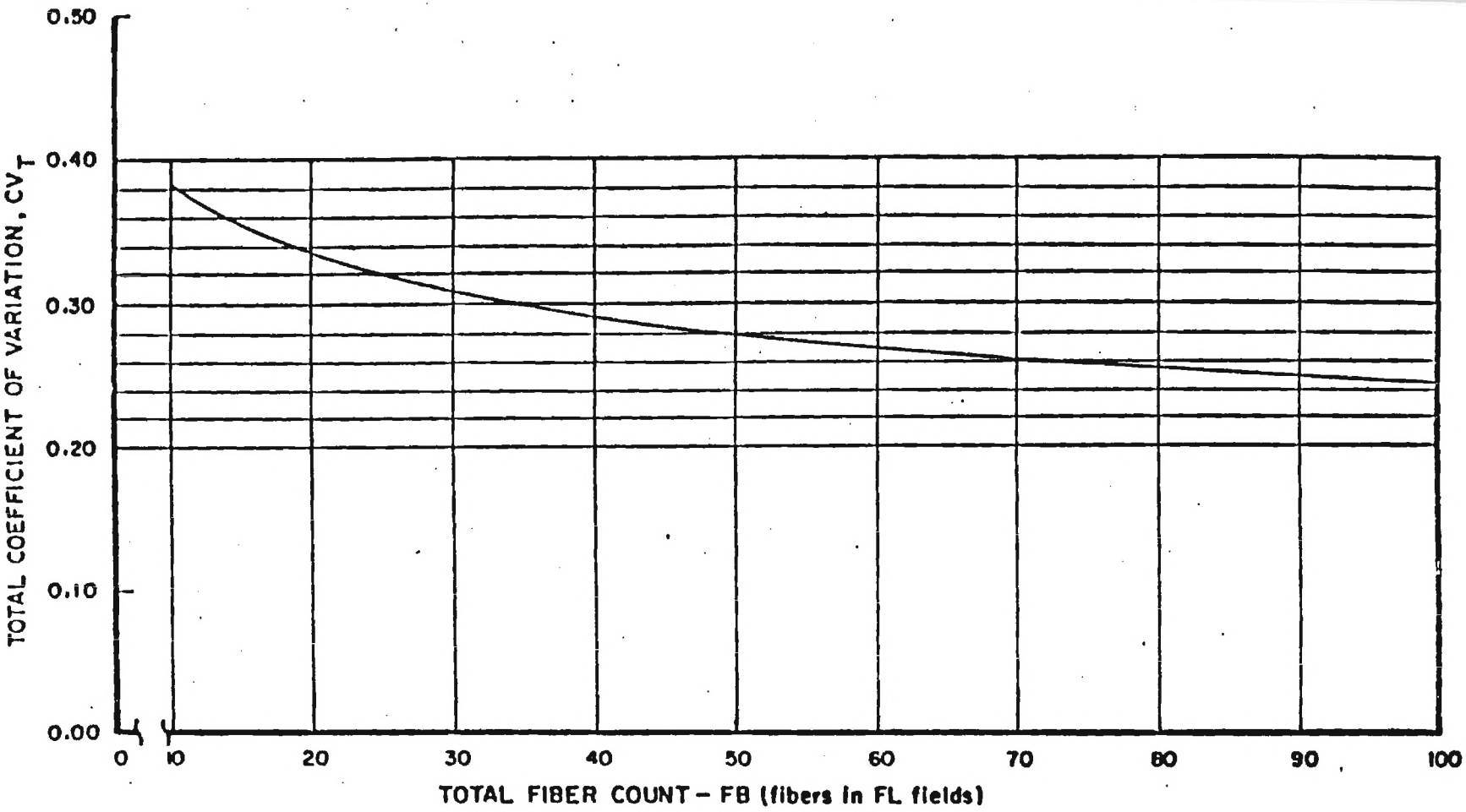

FIGURE 3. Total coefficient of variation as a function of total fiber count

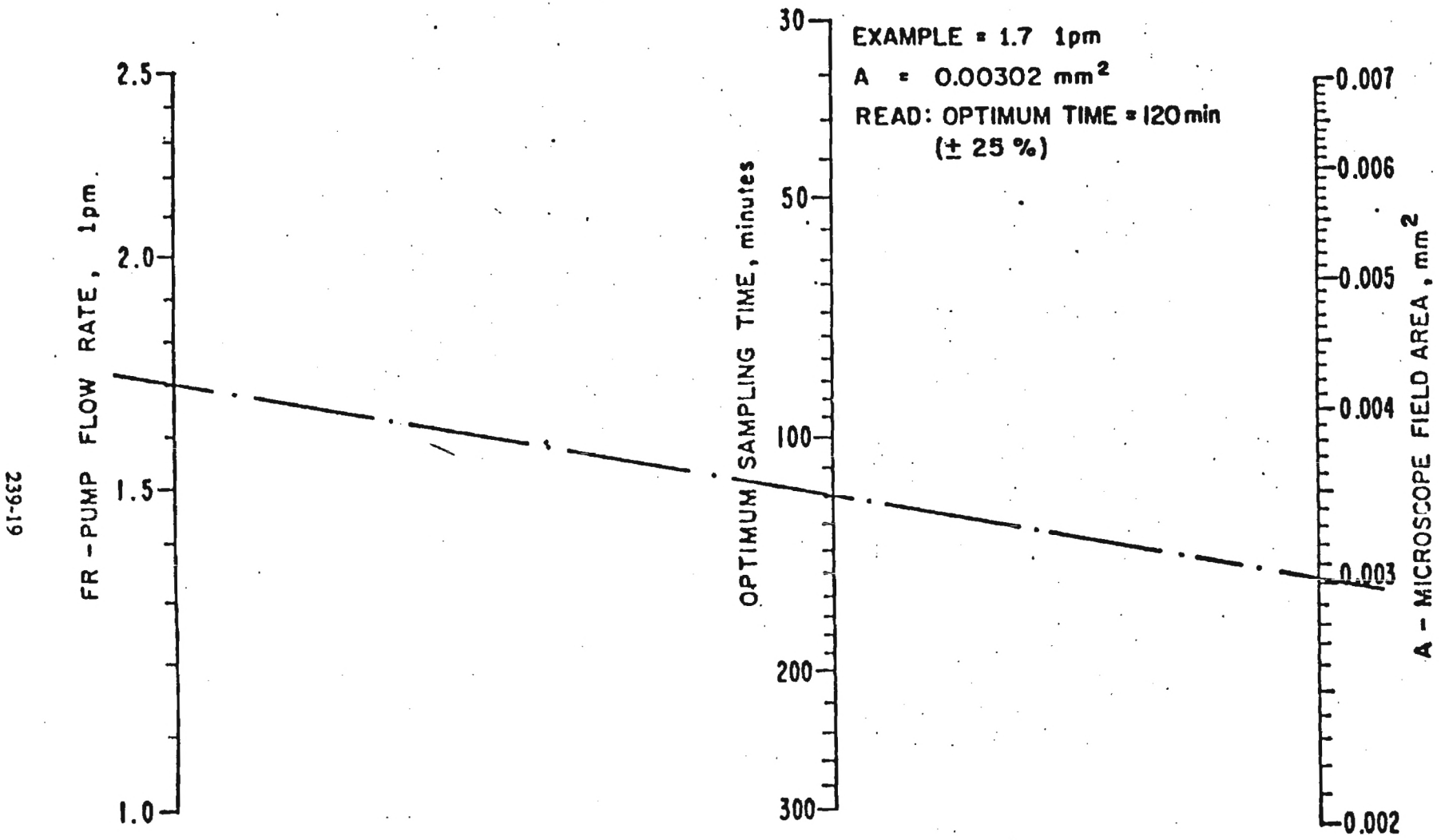

FIGURE 4. Nomogram of optimum sampling times for airborne asbestos fibers in concentrations of 1 to 10 fibers/cm³

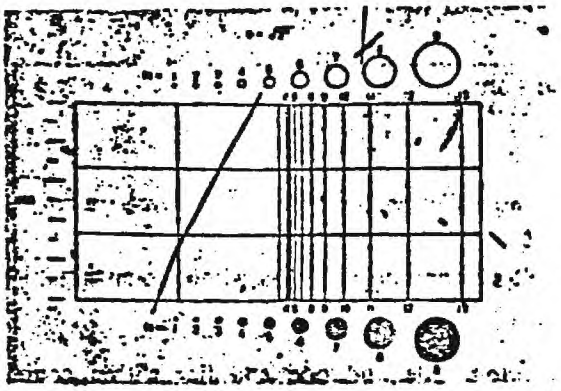

FIGURE 5

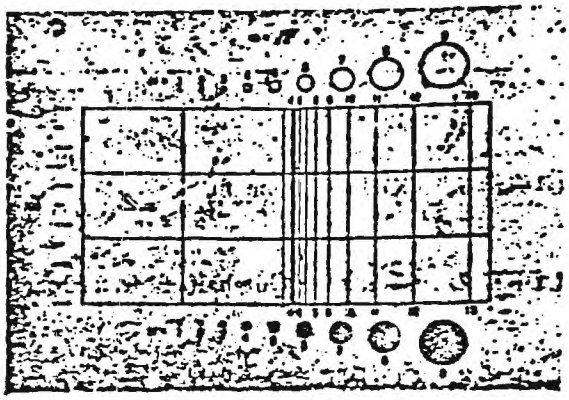

FIGURE 6

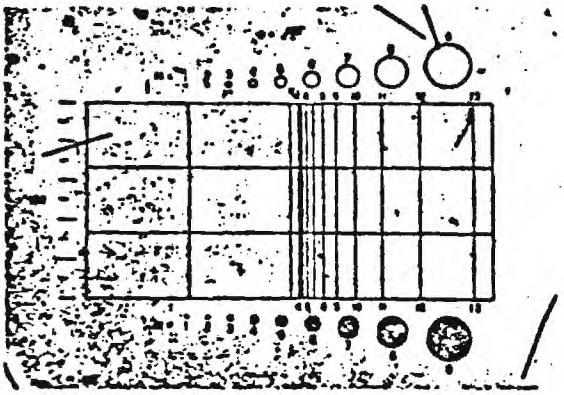

FIGURE 7

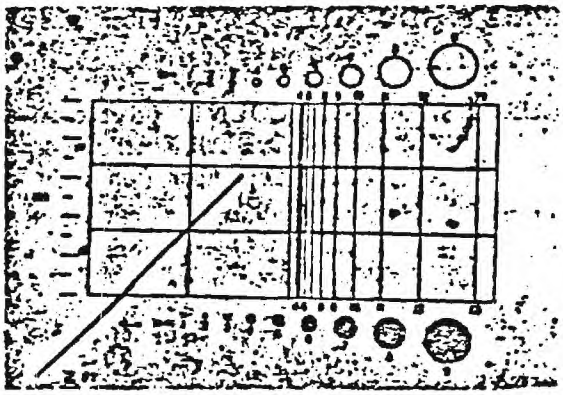

FIGURE 8

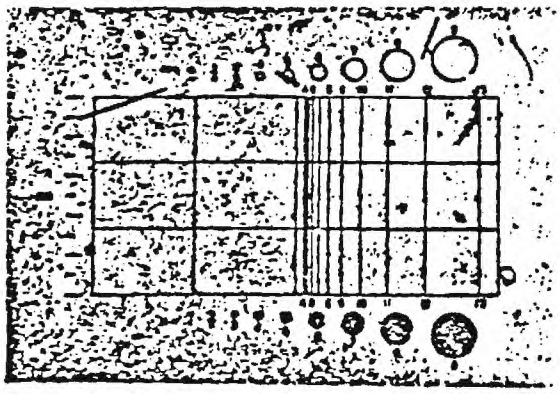

FIGURE 9

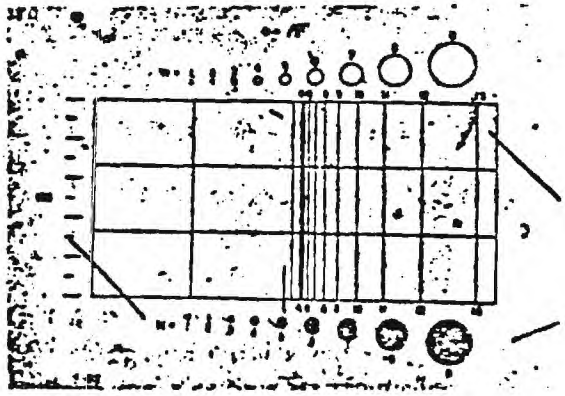

FIGURE 10

LIST OF FIGURES

(5 through 10)

APPENDIX D

OSHA ASBESTOS STANDARD 29 CFR 1910.1001

EPA NATIONAL EMISSION STANDARD - ASBESTOS 40 CFR 61

OSHA

1910.1001 - ASBESTOS

(a) Definitions

For the purpose of this section.

(1) "Asbestos" includes chrysotile, amosite, crocidolite, tremolite, anthophyllite, and actinolite.

(2) "Asbestos fibers" means asbestos fibers longer than 5 micrometers.

(b) PERMISSIBLE EXPOSURE TO AIRBORNE CONCENTRATIONS OF ASBESTOS FIBERS

(1) Standard effective July 7, 1972. The 8-hour, time-weighted average airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed five fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(2) Standard effective July 1, 1976. The 8-hour, time-weighted average airborne concentrations of asbestos fibers to which any employee may be exposed shall not exceed two fibers, longer than 5 micrometers, per cubic centimeter of air, as determined by the method prescribed in paragraph (e) of this section.

(3) Ceiling concentration. No employee shall be exposed at any time to airborne concentration of asbestos fibers in excess of 10 fibers, longer than 5 micrometers, per cubic centimer of air, as determined by the method prescribed in paragraph (e) of this section.

(c) METHODS OF COMPLIANCE

(1) ENGINEERING METHODS

(i) Engineering controls. Engineering controls, such as but not limited to, isolation, enclosure, exhaust ventilation, and dust collection, shall be used to meet the exposure limits prescribed in paragraph (b) of this section.

(ii) LOCAL EXHAUST VENTILATION

(a) Local exhaust ventilation and dust collection systems shall be designed, constructed, installed, and maintained in accordance with the American National Standard Fundamentals Governing the Design and Operation of Local Exhaust Systems, ANSI Z9.2-1971, which is incorporated by reference herein.

(b) See Section 1910.6 concerning the availability of ANSI-A9.2-1971, and the maintenance of a historic file in connection therewith. The address of the American National Standards Institute is given in Section 1910.100.

(iii) PARTICULAR TOOLS

All hand-operated and power-operated tools which may produce or release asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section, such as, but not limited to, saws, scorers, abrasive wheels, and drills, shall be provided with local exhaust ventilation systems in accordance with subdivision (ii) of this subparagraph.

(2) WORK PRACTICES

(i) Wet methods. Insofar as practicable, asbestos shall be handled, mixed, applied, removed, cut, scored, or otherwise worked in a wet state sufficient to prevent the emission of airborne fibers in excess of the exposure limits prescribed in paragraph (b) of this section, unless the usefulness of the product would be diminished thereby.

(ii) Particular products and operations. No asbestos cement, mortar, coating, grout, plaster, or similar material containing asbestos shall be removed from bags, cartons, or other containers in which they are shipped, without being either wetted, or enclosed, or ventilated so as to prevent effectively the release of airborne asbestos fibers in excess of the limits prescribed in paragraph (b) of this section.

(iii) Spraying, demolition, or removal. Employees engaged in the spraying of asbestos, the removal, or demolition of pipes, structures, or equipment covered or insulated with asbestos, and in the removal or demolition of asbestos insulation or coverings shall be provided with respiratory equipment in accordance with paragraph (d) (2) (iii) of this section and with special clothing in accordance with paragraph (d) (3) of this section.

(d) PERSONAL PROTECTIVE EQUIPMENT

(1) Compliance with the exposure limits prescribed by paragraph (b) of this section may not be achieved by the use of respirators or shift rotation of employees, except:

(i) During the time period necessary to install the engineering controls and to institute the work practices required by paragraph (c) of this section;

(ii) In work situations in which the methods prescribed in paragraph (c) of this section are either technically not feasible or feasible to an extent insufficient to reduce the airborne concentrations of asbestos fibers below the limits prescribed by paragraph (b) of this section; or

(iii) In emergencies.

(iv) Where both respirators and personnel rotation are allowed by subdivision (i) and (ii), or (iii) of this subparagraph, and both are practicable, personnel rotation shall be preferred and used.

(2) Where a respirator is permitted by subparagraph (1) of this paragraph, it shall be selected from among those approved by the Bureau of Mines, Department of the Interior, or the National Institute for Occupational Safety and Health Department, of Health, Education, and Welfare, under the provisions of 30 CFR Part 11 (37 P.R. 6244, March 25, 1972), and shall be used in accordance with subdivisions (i), (ii), (iii), and (iv) of this subparagraph.

(i) Air purifying respirators. A reusable or single use air purifying respirator, or a respirator described in subdivision (ii) or (iii) of this subparagraph, shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour, time-weighted average airborne concentrations of asbestos fibers are reasonably expected to exceed no more than 10 times those limits.

(ii) Powered air purifying respirators. A full facepiece powered air purifying respirator, or a powered air purifying respirator, or a respirator described in subdivision (iii) of this subparagraph, shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour, time-weighted average concentrations of asbestos fibers are reasonably expected to exceed 10 times, but not 100 times, those limits.

(iii) Type "C" supplied-air respirators, continuous flow or pressure-demand class. A type "C" continuous flow or pressure-demand, supplied air respirator shall be used to reduce the concentrations of airborne asbestos fibers in the respirator below the exposure limits prescribed in paragraph (b) of this section, when the ceiling or the 8-hour, time-weighted average airborne concentrations of asbestos fibers are reasonably expected to exceed 100 times those limits.

(iv) ESTABLISHMENT OF A RESPIRATOR PROGRAM

(a) The employer shall establish a respirator program in accordance with the requirements of the American National Standard Practices for respiratory Protection, ANSI Z88.2-1969, which is incorporated by reference herein.

(b) See Section 1910.6 concerning the availability of ANSI Z88.2-1969 and the maintenance of an historic file in connection therewith. The address of the American National Standards Institute is given in Section 1910.100.

(c) No employee shall be assigned to tasks requiring the use of respirators if, based upon his most recent examination, an examining physician determines that the employee will be unable to function normally wearing a respirator, or that the safety or health of the employee or other employees will be impaired by his use of the respirator. Such employee shall be rotated to another job or given the opportunity to transfer to a different position whose duties he is able to perform with the same employer, in the same geographical area and with the same seniority, status, and rate of pay he had just prior to such transfer, if such a different position is available.

(3) Special Clothing: The employer shall provide, and require the use of, special clothing, such as coveralls or similar whole body clothing, head coverings, gloves, and foot coverings for any employee exposed to airborne concentrations of asbestos fibers, which exceed the ceiling level prescribed in paragraph (b) of this section.

(4) Change rooms:

(i) At any fixed place of employment exposed to airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section, the employer shall provide change rooms for employees working regularly at the place.

(ii) Clothes lockers: The employer shall provide two separate lockers or containers for each employee, so separated or isolated as to prevent contamination of the employee's street clothes from his work clothes.

(iii) Laundering:

(a) Laundering of asbestos-contaminated clothing shall be done so as to prevent the release of airborne asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section.

(b) Any employer who gives asbestos-contaminated clothing to another person for laundering shall inform such person of the requirement in (a) of this subdivision to effectively prevent the release of airborne asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section.

(c) Contaminated clothing shall be transported in sealed impermeable bags, or other closed, impermeable bags, or other closed, impermeable containers, and labeled in accordance with paragraph (g) of this section.

(e) METHOD OF MEASUREMENT

All determinations of airborne concentrations of asbestos fibers shall be made by the membrane filter method at 400-450 x (magnification) (4 millimeter objective) with phase contrast illumination.

(f) MONITORING

(1) Initial determinations. Within 6 months of the publication of this section, every employer shall cause every place of employment where asbestos fibers are released to be monitoried in such a way as to determine whether every employee's exposure to asbestos fibers is below the limits prescribed in paragraph (b) of this section. If the limits are exceeded, the employer shall immediately undertake a compliance program in accordance with paragraph (c) of this section.

(2) Personal Monitoring

(i) Samples shall be collected from within the breathing zone of the employees, on membrane filters of 0.8 micrometer porosity mounted in an open-face filter holder. Samples shall be taken for the determination of the 8-hour, time-weighted average airborne concentrations and of the ceiling concentrations of asbestos fibers.

(ii) Sampling frequency and patterns. After the initial determinations required by subparagraph (1) of this paragraph, samples shall be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of employees. In no case shall the sampling be done at intervals greater than 6 months for employees whose exposure to asbestos may reasonably be foreseen to exceed the limits prescribed by paragraph (b) of this section.

(3) Environmental monitoring

(i) Samples shall be collected from areas of a work environment which are representative of the airborne concentrations of asbestos fibers which may reach the breathing zone of employees. Samples shall be collected on a membrane filter of 0.8 micrometer porosity mounted in an open-face filter holder. Samples shall be taken for the determination of the 8-hour, time-weighted average airborne concentrations and of the ceiling concentrations of asbestos fibers.

(ii) Sampling frequency and patterns. After the initial determinations required by subparagraph (1) of this paragraph, samples shall be of such frequency and pattern as to represent with reasonable accuracy the levels of exposure of the employees. In no case shall sampling be at intervals greater than 6 months for employees whose exposures to asbestos may reasonably be foreseen to exceed the exposure limits prescribed in paragraph (b) of this section.

(4) Employee observation of monitoring. Affected employees, or their representatives, shall be given a reasonable opportunity to observe any monitoring required by this paragraph and shall have access to the records thereof.

(g) CAUTION SIGNS AND LABELS

(1) Caution Signs

(i) Posting. Caution signs shall be provided and displayed at each location where airborne concentrations of asbestos fibers may be in excess of the exposure limits prescribed in paragraph (b) of this section. Signs shall be posted at such a distance from such a location so that an employee may read the signs and take necessary protective steps before entering the area marked by the signs. Signs shall be posted at all approaches to areas containing excessive concentrations of airborne asbestos fibers.

(ii) Sign specifications. The warning signs required by subdivision (i) of this subparagraph shall conform to the requirements of 20" x 14" vertical format signs specified in Section 1910.145(d)(4), and to this subdivision. The signs shall display the following legend in the lower panel, with letter sizes and styles of a visibility at least equal to that specified in this subdivision.

LEGEND

	NOTATION
Asbestos	1" Sans Serif, Gothic or Block
Dust Hazard	3/4" Sans Serif, Gothic or Block
Avoid Breathing Dust	1/4" Gothic
Wear Assigned Protective Equipment	1/4" Gothic
Do Not Remain in Area Unless Your Work Requires It	1/4" Gothic
Breathing Asbestos Dust May be Hazardous to Your Health	14 Point Gothic

Spacing between lines shall be at least equal to the height of the upper of any two lines.

(2) Caution Labels

(i) Labeling. Caution labels shall be affixed to all raw materials, mixtures, scrap, waste, debris, and other products containing asbestos fibers, or to their containers, except that no label is required where asbestos fibers have been modified by a bonding agent, coating, binder, or other material so that during any reasonably foreseeable use, handling, storage, disposal, processing, or transportation, no airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section will be released.

(ii) Label specifications. The caution labels required by subdivision (i) of this subparagraph shall be printed in letters of sufficient size and contrast as to be readily visible and legible. The label shall state:

CAUTION
Contains Asbestos Fibers
Avoid creating Dust
Breathing Asbestos Dust May Cause
Serious Bodily Harm

(h) HOUSEKEEPING

(1) Cleaning. All external surfaces in any place of employment shall be maintained free of accumulations of asbestos fibers if, with their dispersion, there would be an excessive concentration.

(2) Waste disposal. Asbestos waste, scrap, debris, bags, containers, equipment, and asbestos-contaminated clothing, consigned for disposal, which may produce in any reasonably foreseeable use, handling, storage, processing, disposal or transportation airborne concentrations of asbestos fibers in excess of the exposure limits prescribed in paragraph (b) of this section shall be collected and disposed of in sealed impermeable bags, or other closed, impermeable containers.

(i) Recordkeeping

(1) Exposure records. Every employer shall maintain records of any personal or environmental monitoring required by this section. Records shall be maintained for a period of at least 20 years and shall be made available upon request to the Assistant Secretary of Labor for Occupational Safety and Health, the Director of the National Institute for Occupational Safety and Health, and to authorized representatives of either.

(2) Employee access. Every employee and former employee shall have reasonable access to any record required to be maintained by subparagraph (1) of this paragraph, which indicates the employee's own exposure to asbestos fibers.

(3) Employee notification. Any employee found to have been exposed at any time to airborne concentrations of asbestos fibers in excess of the limits prescribed in paragraph (b) of this section shall be notified in writing of the exposure as soon as practicable but not later than 5 days of the finding. The employee shall also be timely notified of the corrective action being taken.

(j) MEDICAL EXAMINATIONS

(1) General. The employer shall provide or make available at his cost, medical examinations relative to exposure to asbestos required by this paragraph.

(2) Preplacement. The employer shall provide or make available to each of his employees, within 30 calendar days following his first employment in an occupation exposed to airborne concentrations of asbestos fibers, a comprehensive medical examination, which shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV 1.0).

(3) Annual examinations. On or before January 31, 1973, and at least annually thereafter, every employer shall provide, or make available, comprehensive medical examinations to each of his employees engaged in occupations exposed to airborne concentrations of asbestos fibers. Such annual examination shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV 1.0).

(4) Termination of employment. The employer shall provide, or make available, within 30 calendar days before or after the termination of employment of any employee engaged in an occupation exposed to airborne concentrations of asbestos fibers, a comprehensive medical examination which shall include, as a minimum, a chest roentgenogram (posterior-anterior 14 x 17 inches), a history to elicit symptomatology of respiratory disease, and pulmonary function tests to include forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV 1.0).

(5) Recent examinations. No medical examination is required of any employee, if adequate records show that the employee has been examined in accordance with this paragraph within the past 1-year period.

(6) Medical records.

(i) Maintenance. Employers of employees examined pursuant to this paragraph shall cause to be maintained complete and accurate records of all such medical examinations. Records shall be retained by employers for at least 20 years.

(ii) Access. Records of the medical examinations required by this paragraph shall be provided upon request to employees, designated representatives, and the Assistant Secretary in accordance with 29 CFR 1910.20(a)-(e) and (g)-(i). These records shall also be provided upon the request to the Director of NIOSH. Any physician who conducts a medical examination required by this paragraph shall furnish to the employer of the examined employee all the information specifically required by this paragraph, and any other medical information related to occupational exposure to asbestos fibers.

this part hereby approved by the Administrator as an alternative method for sources subject to § 61.52(b).

(Sec. 114, Clean Air Act as amended (42 U.S.C. 7414))

[38 FR 8826, Apr. 6, 1973, as amended at 40 FR 48299, Oct. 14, 1975; 43 FR 8800, Mar. 3, 1978]

§ 61.15 Availability of information.

The availability to the public of information provided to, or otherwise obtained by, the Administrator under this part shall be governed by Part 2 of this chapter.

(Sec. 114, Clean Air Act as amended (42 U.S.C. 7414))

[41 FR 36918, Sept. 1, 1976, as amended at 43 FR 8800, Mar. 3, 1978]

§ 61.16 State authority.

(a) The provisions of this part shall not be construed in any manner to preclude any State or political subdivision thereof from:

(1) Adopting and enforcing any emission limiting regulation applicable to a stationary source, provided that such emission limiting regulation is not less stringent than the standards prescribed under this part.

(2) Requiring the owner or operator of a stationary source, other than a stationary source owned or operated by the United States, to obtain permits, licenses, or approvals prior to initiating construction, modification, or operation of such source.

(Sec. 116, Clean Air Act as amended (42 U.S.C. 7416))

[38 FR 8826, Apr. 6, 1973, as amended at 43 FR 8800, Mar. 3, 1978]

§ 61.17 Circumvention.

No owner or operator subject to the provisions of this part shall build, erect, install, or use any article machine, equipment, process, or method, the use of which conceals an emission which would otherwise constitute a violation of an applicable standard. Such concealment includes, but is not limited to, the use of gaseous dilutants to achieve compliance with a visible emissions standard, and the piecemeal carrying out of an operation to avoid only to operations larger than a specified size.

[40 FR 48299, Oct. 14, 1975]

Subpart B—National Emission Standard for Asbestos

§ 61.20 Applicability.

The provisions of this subpart are applicable to those sources specified in § 61.22.

§ 61.21 Definitions.

Terms used in this subpart are defined in the act, in Subpart A of this part, or in this section as follows:

(a) "Asbestos" means actinolite, amosite, anthophyllite, chrysotile, crocidolite, tremolite.

(b) "Asbestos material" means asbestos or any material containing asbestos.

(c) "Particulate asbestos material" means finely divided particles of asbestos material.

(d) "Asbestos tailings" means any solid waste product of asbestos mining or milling operations which contains asbestos.

(e) "Outside air" means the air outside buildings and structures.

(f) "Visible emissions" means any emissions which are visually detectable without the aid of instruments and which contain particulate asbestos material.

(g) "Asbestos mill" means any facility engaged in the conversion of any intermediate step in the conversion of asbestos or into commercial asbestos. Outside storage of asbestos materials is not considered a part of such facility.

(h) "Commercial asbestos" means any variety of asbestos which is produced by extracting asbestos from asbestos ore.

(i) "Manufacturing" means the combining of commercial asbestos, or in the case of woven friction products the combining of textiles containing commercial asbestos, with any other material(s), including commercial asbestos, and the processing of this combination into a product as specified in § 61.22(c).

(j) "Demolition" means the wrecking or taking out of any load-supporting

materials.

(k) "Friable asbestos material" means any material that contains more than 1 percent asbestos by weight and that can be crumbled, pulverized, or reduced to powder, when dry, by hand pressure.

(l) "Control device asbestos waste" means any asbestos-containing waste material that is collected in a pollution control device.

(m) "Renovation" means the removing or stripping of friable asbestos material used on any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member. Operations in which load-supporting structural members are wrecked or taken out are excluded.

(n) "Planned renovation" means a renovation operation, or a number of such operations, in which the amount of friable asbestos material that will be removed or stripped within a given period of time can be predicted. Operations that are individually non-scheduled are included, provided a number of such operations can be predicted to occur during a given period of time based on operating experience.

(o) "Emergency renovation" means a renovation operation that results from a sudden, unexpected event, and is not a planned renovation. Operations necessitated by non-routine failures of equipment are included.

(p) "Adequately wetted" means sufficiently mixed or coated with water or an aqueous solution to prevent dust emissions.

(q) "Removing" means taking out friable asbestos materials used on any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member from any building, structure, facility, or installation.

(r) "Stripping" means taking off friable asbestos materials from any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member.

(s) "Fabricating" means any processing of a manufactured product containing commercial asbestos, with the exception of processing at temporary sites for the construction or restoration of buildings, structures, facilities or installations.

thereof where additional asbestos-containing waste material will not be deposited and where the surface is not disturbed by vehicular traffic.

(u) "Active waste disposal site" means any disposal site other than an inactive site.

(v) "Roadways" means surfaces on which motor vehicles travel including, but not limited to, highways, roads, streets, parking areas, and driveways.

(w) "Asbestos-containing waste material" means any waste which contains commercial asbestos and is generated by a source subject to the provisions of this subpart, including asbestos mill tailings, control device asbestos waste, friable asbestos waste material, and bags or containers that previously contained commercial asbestos.

(x) "Structural member" means any load-supporting member, such as beams and load-supporting walls; or any non-load-supporting member, such as ceilings and non-load-supporting walls.

[38 FR 8826, Apr. 6, 1973, as amended at 39 FR 15398, May 3, 1974; 40 FR 48299, Oct. 14, 1975; 42 FR 12127, Mar. 2, 1977; 43 FR 26373, June 19, 1978]

§ 61.22 Emission standard.

(a) Asbestos mills: There shall be no visible emissions to the outside air from any asbestos mill except as provided in paragraph (f) of this section.

(b) Roadways: The surfacing of roadways with asbestos tailings or with asbestos-containing waste that is generated by any source subject to paragraphs (c), (d), (e) or (h) of this section is prohibited, except for temporary roadways on an area of asbestos ore deposits. The deposition of asbestos tailings or asbestos-containing waste on roadways covered with snow or ice is considered "surfacing."

(c) Manufacturing: There shall be no visible emissions to the outside air, except as provided in paragraph (f) of this section, from any of the following operations if they use commercial asbestos or from any building or structure in which such operations are conducted.

(1) The manufacture of cloth, cord, wicks, tubing, tape, twine, rope,

(3) The manufacture of fireproofing and insulating materials.

(4) The manufacture of friction products.

(5) The manufacture of paper, millboard, and felt.

(6) The manufacture of floor tile.

(7) The manufacture of paints, coatings, caulks, adhesives, sealants.

(8) The manufacture of plastics and rubber materials.

(9) The manufacture of chlorine.

(10) The manufacture of shotgun shells.

(11) The manufacture of asphalt concrete.

(d) Demolition and renovation: The requirements of this paragraph shall apply to any owner or operator of a demolition or renovation operation who intends to demolish any institutional, commercial, or industrial building (including apartment buildings having more than four dwelling units), structure, facility, installation, or portion thereof, which contains any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member that is covered or coated with friable asbestos material, except as provided in paragraph (d)(1) of this section; or who intends to renovate any institutional, commercial, or industrial building, structure, facility, installation, or portion thereof where more than 80 meters (ca. 260 feet) of pipe covered or coated with friable asbestos material are stripped or removed, or more than 15 square meters (ca. 160 square feet) of friable asbestos material used to cover or coat any duct, boiler, tank, reactor, turbine, furnace, or structural member are stripped or removed.

(1)(i) The owner or operator of a demolition operation is exempted from the requirements of this paragraph: *Provided*, (A) the amount of friable asbestos material in the building or portion thereof to be demolished is less than 80 meters (ca. 260 feet) used to insulate pipes, and less than 15 square meters (ca. 160 square feet) used to insulate or fireproof any duct, boiler, tank, reactor, turbine, furnace, or structural member, and (B) the notification requirements of paragraph (d)(1)(ii) are met.

(ii) Owners or operators of demolition operations are exempted from the requirements of paragraphs (d)(2) and (3) of this section if they: (A) Are not regularly in the business of demolition, and (B) are performing the demolition operation in or on the building in which they reside.

(2) Asbestos materials on a roof need not be removed before demolition if they are not friable and will be disposed of with a load consisting predominantly of nonasbestos material.

(3) Any friable asbestos materials which are to be disposed of with a load of nonasbestos material must be removed to the extent practicable before demolition.

(4) Any friable asbestos materials which are not removed before demolition must be removed before the disposal site is covered.

(5) Any friable asbestos materials which are not removed before demolition must be identified as asbestos-containing before they are buried, dumped, or mixed with nonasbestos material.

(6) In the case of emergency demolitions ordered to abate imminent hazards, the requirements of paragraph (d)(2) of this section shall not apply. Instead, the owner or operator of the demolition operation shall notify the Administrator by telephone as soon as possible before the demolition begins, and shall include in the notification the name and location of the demolition, the reason why it is an emergency, a description of the damage to the facility, the extent to which friable asbestos materials are involved, and the amount of friable asbestos materials estimated to be involved in the demolition. The owner or operator shall also comply with the requirements of paragraph (d)(2) of this section as soon as possible.

(7) The owner or operator of a demolition or renovation operation shall not begin such an operation unless the following requirements are met:

(i) Notification has been given as described in paragraph (d)(2) of this section, except for those demolitions described in paragraph (d)(6) of this section.

(ii) Any applicable waiting period specified in paragraph (d)(2) of this section has expired.

(iii) No visible emissions will occur from the operation.

(iv) Any friable asbestos materials which have been stripped or removed pursuant to paragraph (d)(4) of this section remain adequately wetted until they are disposed of.

(v) All friable asbestos materials are properly disposed of as described in paragraph (d)(5) of this section.

(vi) Any friable asbestos materials which are not removed before demolition are adequately wetted during demolition.

(vii) For any demolition operation conducted in a county with a population of less than 50,000 persons according to the most recent Bureau of the Census data, the requirements of paragraphs (d)(7)(iii), (iv), (v), and (vi) of this section do not apply.

(8) The owner or operator of a demolition or renovation operation shall comply with all the requirements of this paragraph.

(9) The owner or operator of a demolition or renovation operation shall designate a person or persons trained in the requirements of this paragraph and the means of implementing them as responsible for its observance.

(10) For any demolition or renovation operation not covered by paragraph (d)(1)(i), the owner or operator shall thoroughly inspect the affected facility or part of the facility where the demolition or renovation operation will occur for the presence of asbestos, including category I nonfriable asbestos-containing roofing material and other category I nonfriable asbestos-containing material known to be present, before the demolition or renovation. The owner or operator shall include the information required by paragraph (d)(2) of this section, with the exception of the information required by paragraphs (d)(2)(iii), (vi), (vii), (viii), and (ix), and shall state the measured or estimated amount of friable asbestos materials which is present. Techniques of estimation shall be explained.

(2) Written notice of intention to demolish or renovate shall be provided to the Administrator by the owner or operator of the demolition or renovation operation. Such notice shall be postmarked or delivered to the Administrator at least 10 days prior to commencement of demolition, or as early as possible prior to commencement of emergency demolition subject to paragraph (d)(6) of this section, and as early as possible prior to commencement of renovation. Such notice shall include the following information:

(i) Name of owner or operator.

(ii) Address of owner or operator.

(iii) Description of the building, structure, facility, or installation to be demolished or renovated, including the size, age, and prior use of the structure, and the approximate amount of friable asbestos materials present.

(iv) Address or location of the building, structure, facility, or installation.

(v) Scheduled starting and completion dates of demolition or renovation.

(vi) Nature of planned demolition or renovation and method(s) to be employed.

(vii) Procedures to be employed to meet the requirements of this paragraph and paragraph (j) of this section.

(viii) The name and address or location of the waste disposal site where the friable asbestos waste will be deposited.

(ix) Name, title, and authority of the State or local governmental representative who has ordered a demolition which is subject to paragraph (d)(6) of this section.

(3)(i) For purposes of determining whether a planned renovating operation constitutes a renovation within the meaning of this paragraph, the amount of friable asbestos material that will be removed or stripped shall be the total amount of friable asbestos material that can be predicted to be removed or stripped at a source over the maximum period of time for which a prediction can be made. The period shall be not less than 30 days and not longer than one year.

(B) For each planned renovating operation not covered by paragraph (d)(3)(i)(A), the total amount of friable asbestos material that can be predicted will be removed or stripped at a source.

(ii) For purposes of determining whether an emergency renovating operation constitutes a renovation within the meaning of this paragraph, the amount of friable asbestos material to be removed or stripped shall be the total amount of friable asbestos material that will be removed or stripped as a result of the sudden, unexpected event that necessitated the renovation.

(4) The following procedures shall be used to prevent emissions of particulate asbestos material to outside air:

(i) Friable asbestos materials, used on any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member, shall be removed from any building, structure, facility or installation subject to this paragraph. Such removal shall occur before wrecking or dismantling of any portion of such building, structure, facility, or installation that would break up the friable asbestos materials and before wrecking or dismantling of any other portion of such building, structure, facility, or installation that would preclude access to such materials for subsequent removal. Removal of friable asbestos materials used on any pipe, duct, or structural member which are encased in concrete or other similar structural material is not required prior to demolition, but such material shall be adequately wetted whenever exposed during demolition.

(ii) Friable asbestos materials used on pipes, ducts, boilers, tanks, reactors, turbines, furnaces, or structural members shall be adequately wetted during stripping, except as provided in paragraph (d)(4)(iv). Such materials that are not removed or stripped as units or in sections shall be adequately wetted during removal and handling.

(iii) Friable asbestos materials used on any pipe, duct, boiler, tank, reactor, turbine, furnace, or structural member that has been removed as a unit or in sections as provided in paragraph (d)(4)(iii) of this section shall be performed in accordance with paragraph (d)(4)(ii) of this section. Rather than comply with the wetting requirement, a local exhaust ventilation and collection system may be used to prevent emissions to the outside air. Such local exhaust ventilation systems shall be designed and operated to capture the asbestos particulate matter produced by the stripping of friable asbestos material. There shall be no visible emissions to the outside air from such local exhaust ventilation and collection systems except as provided in paragraph (f) of this section.

(v) All friable asbestos materials that have been removed or stripped shall be adequately wetted to ensure that such materials remain wet during all remaining stages of demolition or renovation and related handling operations. Such materials shall not be dropped or thrown to the ground or a lower floor. Such materials that have been removed or stripped more than 50 feet above ground level, except those materials removed as units or in sections, shall be transported to the ground via dust-tight chutes or containers.

(vi) Except as specified below, the wetting requirements of this paragraph are suspended when the temperature at the point of wetting is below 0°C (32°F). When friable asbestos materials are not wetted due to freezing temperatures, such materials

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on pi ducts, boilers, tanks, reactors, turbines, furnaces, or structural members shall, to the maximum extent possible, be removed as units or in sections prior to wrecking. In no case shall the requirements of paragraphs (d)(4)(iv) or (d)(4)(v) be suspended due to freezing temperatures.

(vii) For renovation operations, local exhaust ventilation and collection systems may be used, instead of wetting as specified in paragraph (d)(4)(ii), to prevent emissions of particulate asbestos material to outside air when damage to equipment resulting from the wetting would be unavoidable. Upon request and supply of adequate information, the Administrator will determine whether damage to equipment resulting from wetting to comply with the provisions of this paragraph would be unavoidable. Such local exhaust ventilation systems shall be designed and operated to capture the asbestos particulate matter produced by the stripping and removal of friable asbestos material. There shall be no visible emissions to the outside air from such local exhaust ventilation and collection systems, except as provided in paragraph (f) of this section.

(5) Sources subject to this paragraph are exempt from the requirements of §§ 61.05(a), 61.07, and 61.09.

(6) The demolition of a building, structure, facility, or installation, pursuant to an order of an authorized representative of a State or local governmental agency, issued because that building is structurally unsound and in danger of imminent collapse is exempt from all but the following requirements of paragraph (d) of this section:

(i) The notification requirements specified by paragraph (d)(2) of this section;

(ii) The requirements on stripping of friable asbestos materials from previously removed units or sections as specified in paragraph (d)(4)(iv) of this section;

(iii) The wetting, as specified by paragraph (d)(4)(v) of this section, of friable asbestos materials that have been removed or stripped;

(iv) The portion of the structure being demolished that contains friable asbestos materials shall be adequately wetted during the wrecking operation.

(e) Spraying: There shall be no visible emissions to the outside air from the spray-on application of materials containing more than 1 percent asbestos, on a dry weight basis, used on equipment and machinery, except as provided in paragraph (f) of this section. Materials sprayed on buildings, structures, pipes, and conduits shall contain less than 1 percent asbestos on a dry weight basis.

(1) Sources subject to this paragraph are exempt from the requirements of § 61.05(a), § 61.07, and § 61.09.

(2) Any owner or operator who intends to spray asbestos materials which contain more than 1 percent asbestos on a dry weight basis to insulate or fireproof equipment and machinery shall report such intention to the Administrator at least 20 days prior to the commencement of the spraying operation. Such report shall include the following information:

(i) Name of owner or operator.

(ii) Address of owner or operator.

(iii) Location of spraying operation.

(iv) Procedures to be followed to meet the requirements of this paragraph.

(3) The spray-on application of materials in which the asbestos fibers are encapsulated with a bituminous or resinous binder during spraying and which are not friable after drying is exempted from the requirements of paragraphs (e) and (e)(2) of this section.

(f) Rather than meet the no-visible-emission requirements as specified by paragraphs (a), (c), (d), (e), (h), (j), and (k) of this section, an owner or operator may elect to use the methods specified by § 61.23 to clean emissions containing particulate asbestos material before such emissions escape to, or are vented to, the outside air.

(g) Where the presence of uncombined water is the sole reason for failure to meet the no-visible-emission requirement of paragraphs (a), (c), (d), (e), (h), (j), or (k) of this section, such failure shall not be a violation of such emission requirements.

(h) Fabricating: There shall be no visible emissions to the outside air, except as provided in paragraph (f) of this section, from any of the following operations if they use commercial asbestos or from any building or structure in which such operations are conducted.

(1) The fabrication of cement building products.

(2) The fabrication of friction products, except those operations that primarily install asbestos friction materials on motor vehicles.

(3) The fabrication of cement or silicate board for ventilation hoods; ovens; electrical panels; laboratory furniture; bulkheads, partitions and ceilings for marine construction; and flow control devices for the molten metal industry.

(i) Insulating: Molded insulating materials which are friable and wet-applied insulating materials which are friable after drying, installed after the effective date of these regulations, shall contain no commercial asbestos. The provisions of this paragraph do not apply to insulating materials which are spray applied; such materials are regulated under § 61.22(e).

(j) Waste disposal for manufacturing, fabricating, demolition, renovation and spraying operations: The owner or operator of any source covered under the provisions of paragraphs (c), (d), (e), or (h) of this section shall meet the following standards:

(1) There shall be no visible emissions to the outside air, except as provided in paragraph (j)(3) of this section, during the collection; processing, including incineration; packaging; transporting; or deposition of any asbestos-containing waste material which is generated by such source.

(2) All asbestos-containing waste material shall be deposited at waste disposal sites which are operated in accordance with the provisions of § 61.25.

(3) Rather than meet the requirement of paragraph (j)(1) of this section, an owner or operator may elect to use either of the disposal methods specified under (j)(3) (i) and (ii) of this section, or an alternative disposal method which has received prior approval by the Administrator:

(i) Treatment of asbestos-containing waste material with water:

(A) Control device asbestos waste shall be thoroughly mixed with water into a slurry and all asbestos-containing waste material shall be adequately wetted. There shall be no visible emissions to the outside air from the collection, mixing and wetting operations, except as provided in paragraph (f) of this section.

(B) After wetting, all asbestos-containing waste material shall be sealed into leak-tight containers while wet, and such containers shall be deposited at waste disposal sites which are operated in accordance with the provisions of § 61.25.

(C) The containers specified under paragraph (j)(3)(i)(B) of this section shall be labeled with a warning label that states:

CAUTION

Contains Asbestos

Avoid Opening or

Breaking Container

Breathing Asbestos is Hazardous

to Your Health

Alternatively, warning labels specified by Occupational Safety and Health Standards of the Department of Labor, Occupational Safety and Health Administration (OSHA) under 29 CFR 1910.93a(g)(2)(ii) may be used.

(ii) Processing of asbestos-containing waste material into non-friable forms:

(A) All asbestos-containing waste material shall be formed into non-friable pellets or other shapes and deposited at waste disposal sites which are operated in accordance with the provisions of § 61.25.

(B) There shall be no visible emissions to the outside air from the collection and processing of asbestos-containing waste material, except as specified in paragraph (f) of this section.

(4) For the purposes of this paragraph (j), the term all asbestos-containing waste material as applied to demolition and renovation operations covered by paragraph (d) of this section includes only friable asbestos waste and control device asbestos waste.

(k) Waste disposal for asbestos mills: The owner or operator of any source covered under the provisions of para-

(1) There shall be no visible emissions to the outside air, except as provided in paragraph (k)(3) of this section, during the collection, processing, packaging, transporting or deposition of any asbestos-containing waste material which is generated by such source.

(2) All asbestos-containing waste material shall be deposited at waste disposal sites which are operated in accordance with the provisions of § 61.25.

(3) Rather than meet the requirement of paragraph (k)(1) of this section, an owner or operator may elect to meet the following requirements in paragraphs (k)(3) (i) and (ii), or use an alternative disposal method which has received prior approval by the Administrator:

(i) There shall be no visible emissions to the outside air from the transfer of control device asbestos waste to the tailings conveyor, except as provided in paragraph (f) of this section. Such waste shall be subsequently processed either as specified in paragraph (k)(3)(ii) of this section or as specified in paragraph (j)(3) of this section.

(ii) All asbestos-containing waste material shall be adequately mixed, with a wetting agent recommended by the manufacturer of the agent to effectively wet dust and tailings, prior to deposition at a waste disposal site. Such agent shall be used as recommended for the particular dust by the manufacturer of the agent. There shall be no discharge of visible emissions to the outside air from the wetting operation except as specified in paragraph (f) of this section. Wetting may be suspended when the ambient temperature at the waste disposal site is less than −9.5° C (ca. 15° F). The ambient air temperature shall be determined by an appropriate measurement method with an accuracy of ±1° C (±2° F) and recorded at least at hourly intervals during the period that the operation of the wetting system is suspended. Records of such temperature measurements shall be retained at the source for a minimum of 2 years and made available for inspection by the Administrator.

(l) The owner of any inactive waste disposal site, which was operated by [illegible] waste material produced by such sources was deposited, shall meet the following standards:

(1) There shall be no visible emissions to the outside air from an inactive waste disposal site subject to this paragraph, except as provided in paragraph (l)(5) of this section.

(2) Warning signs shall be displayed at all entrances, and along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material was deposited, at intervals of 100 m (ca. 330 ft) or less, except as specified in paragraph (l)(4) of this section. Signs shall be posted in such a manner and location that a person may easily read the legend. The warning signs required by this paragraph shall conform to the requirements of 20" x 14" upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph. The signs shall display the following legend in the lower panel, with letter sizes and styles of a visibility at least equal to those specified in this paragraph.

LEGEND

ASBESTOS WASTE DISPOSAL SITE

DO NOT CREATE DUST

Breathing Asbestos is Hazardous to Your Health

Notation

1" Sans Serif, Gothic or Block

¾" Sans Serif, Gothic or Block

14 Point Gothic

Spacing between lines shall be at least equal to the height of the upper of the two lines.

(3) The perimeter of the site shall be fenced in a manner adequate to deter access by the general public, except as specified in paragraph (l)(4) of this section.

(4) Warning signs and fencing are not required where the requirements of paragraphs (l)(5) (i) or (ii) of this section are met, or where a natural barrier adequately deters access by the general public. Upon request and supply of appropriate information, the Administrator will determine whether [illegible]

(5) Rather than meet the requirement of paragraph (l)(1) of this section, an owner may elect to meet the requirements of this paragraph or may use an alternative control method for emissions from inactive waste disposal sites which has received prior approval by the Administrator.

(i) The asbestos-containing waste material shall be covered with at least 15 centimeters (ca. 6 inches) of compacted non-asbestos-containing material, and a cover of vegetation shall be grown and maintained on the area adequate to prevent exposure of the asbestos-containing waste material; or

(ii) The asbestos-containing waste material shall be covered with at least 60 centimeters (ca. 2 feet) of compacted non-asbestos-containing material and maintained to prevent exposure of the asbestos-containing waste; or

(iii) For inactive waste disposal sites for asbestos tailings, a resinous or petroleum-based dust suppression agent which effectively binds dust and controls wind erosion shall be applied. Such agent shall be used as recommended for the particular asbestos tailings by the dust suppression agent manufacturer. Other equally effective dust suppression agents may be used upon prior approval by the Administrator. For purposes of this paragraph, waste crankcase oil is not considered a dust suppression agent.

[38 FR 8826, Apr. 6, 1973, as amended at 39 FR 15398, May 3, 1974; 40 FR 48299, Oct. 14, 1975; 43 FR 26374, June 19, 1978]

§ 61.23 Air-cleaning.

If air-cleaning is elected, as permitted by §§ 61.22(f) and 61.22(d)(4)(iv), the requirements of this section must be met.

(a) Fabric filter collection devices must be used, except as noted in paragraphs (b) and (c) of this section. Such devices must be operated at a pressure drop of no more than 4 inches water gage, as measured across the filter fabric. The airflow permeability, as determined by ASTM method D737-69, must not exceed 30 $ft^3/min/ft^2$ for woven fabrics or 35 $ft^3/min/ft^2$ for felted fabrics, except that 40 $ft^3/min/ft^2$ for woven and 45 $ft^3/min/ft^2$ for felted fabrics is allowed for filtering [illegible] weigh at least 14 ounces and be at least one-sixteenth inch thick throughout. Synthetic fabrics must not contain fill yarn other than that which is spun.

(b) If the use of fabric filters creates a fire or explosion hazard, the administrator may authorize the use of wet collectors designed to operate with a unit contacting energy of at least 40 inches water gage pressure.

(c) The administrator may authorize the use of filtering equipment other than that described in paragraphs (a) and (b) of this section if the owner or operator demonstrates to the satisfaction of the administrator that the filtering of particulate asbestos material is equivalent to that of the described equipment.

(d) All air-cleaning equipment authorized by this section must be properly installed, used, operated, and maintained. Bypass devices may be used only during upset or emergency conditions and then only for so long as it takes to shut down the operation generating the particulate asbestos material.

[38 FR 8826, Apr. 6, 1973, as amended at 40 FR 48302, Oct. 14, 1975]

§ 61.24 Reporting.

The owner or operator of any existing source to which this subpart is applicable shall, within 90 days after the effective date, provide the following information to the administrator:

(a) A description of the emission control equipment used for each process;

(b) If a fabric filter device is used to control emissions, the pressure drop across the fabric filter in inches water gage.

(1) If the fabric filter device utilizes a woven fabric, the airflow permeability in $ft^3/min/ft^2$ and, if the fabric is synthetic, indicate whether the fill yarn is spun or not spun.

(2) If the fabric filter device utilizes a felted fabric, the density in oz/yd^2, the minimum thickness in inches, and the airflow permeability in $ft^3/min/ft^2$.

(c) For sources subject to §§ 61.22(j) and 61.22(k):

waste material.

(2) The average weight of asbestos-containing waste material disposed of, measured in kg/day.

(3) The emission control methods used in all stages of waste disposal.

(4) The type of disposal site or incineration site used for ultimate disposal, the name of the site operator, and the name and location of the disposal site.

(d) For sources subject to § 61.22(l):

(1) A brief description of the site.

(2) The method or methods used to comply with the standard, or alternative procedures to be used.

(e) Such information shall accompany the information required by § 61.10. The information described in this section shall be reported using the format of Appendix A of this part.

(Sec. 114, Clean Air Act as amended (42 U.S.C. 7414))

[38 FR 8826, Apr. 6, 1973, as amended at 40 FR 48302, Oct. 14, 1975; 43 FR 8800, Mar. 3, 1978]

§ 61.25 Waste disposal sites.

In order to be an acceptable site for disposal of asbestos-containing waste material under § 61.22(j) and (k), an active waste disposal site shall meet the requirements of this section.

(a) There shall be no visible emissions to the outside air from any active waste disposal site where asbestos-containing waste material has been deposited, except as provided in paragraph (e) of this section.

(b) Warning signs shall be displayed at all entrances, and along the property line of the site or along the perimeter of the sections of the site where asbestos-containing waste material is deposited, at intervals of 100 m (ca. 330 ft) or less except as specified in paragraph (d) of this section. Signs shall be posted in such a manner and location that a person may easily read the legend. The warning signs required by this paragraph shall conform to the requirements of 20" × 14" upright format signs specified in 29 CFR 1910.145(d)(4) and this paragraph. The signs shall display the following legend in the lower panel, with letter sizes and styles of a visibility at

LEGEND

ASBESTOS WASTE DISPOSAL SITE

Do Not Create Dust

Breathing Asbestos is Hazardous to Your Health

Notation

1" Sans Serif, Gothic or Block

¾" Sans Serif, Gothic or Block

14 Point Gothic

Spacing between lines shall be at least equal to the height of the upper of the two lines.

(c) The perimeter of the disposal site shall be fenced in order to adequately deter access to the general public except as specified in paragraph (d) of this section.

(d) Warning signs and fencing are not required where the requirements of paragraph (e)(1) of this section are met, or where a natural barrier adequately deters access to the general public. Upon request and supply of appropriate information, the Administrator will determine whether a fence or a natural barrier adequately deters access to the general public.

(e) Rather than meet the requirement of paragraph (a) of this section, an owner or operator may elect to meet the requirements of paragraph (e)(1) or (e)(2) of this section, or may use an alternative control method for emissions from active waste disposal sites which has received prior approval by the Administrator.

(1) At the end of each operating day, or at least once every 24-hour period while the site is in continuous operation, the asbestos-containing waste material which was deposited at the site during the operating day or previous 24-hour period shall be covered with at least 15 centimeters (ca. 6 inches) of compacted non-asbestos-containing material.

(2) At the end of each operating day, or at least once every 24-hour period while the disposal site is in continuous operation, the asbestos-containing waste material which was deposited at the site during the operating day or previous 24-hour period shall be covered with a resinous or petroleum-

recommended for the particular dust by the dust suppression agent manufacturer. Other equally effective dust suppression agents may be used upon prior approval by the Administrator. For purposes of this paragraph, waste crankcase oil is not considered a dust suppression agent.

[40 FR 48302, Oct. 14, 1975]

Subpart C—National Emission Standard for Beryllium

§61.30 Applicability.

The provisions of this subpart are applicable to the following stationary sources:

(a) Extraction plans, ceramic plants, foundries, incinerators, and propellant plants which process beryllium ore, beryllium, beryllium oxide, beryllium alloys, or beryllium-containing waste.

(b) Machine shops which process beryllium, beryllium oxides, or any alloy when such alloy contains more than 5 percent beryllium by weight.

§61.31 Definitions.

Terms used in this subpart are defined in the act, in subpart A of this part, or in this section as follows:

(a) "Beryllium" means the element beryllium. Where weights or concentrations are specified, such weights or concentrations apply to beryllium only, excluding the weight or concentration of any associated elements.

(b) "Extraction plant" means a facility chemically processing beryllium ore to beryllium metal, alloy, or oxide, or performing any of the intermediate steps in these processes.

(c) "Beryllium ore" means any naturally occurring material mined or gathered for its beryllium content.

(d) "Machine shop" means a facility performing cutting, grinding, turning, honing, milling, deburring, lapping, electrochemical machining, etching, or other similar operations.

(e) "Ceramic plant" means a manufacturing plant producing ceramic items.

(f) "Foundry" means a facility engaged in the melting or casting of beryllium metal or alloy.

used or generated during any process or operation performed by a source subject to this subpart.

(h) "Incinerator" means any furnace used in the process of burning waste for the primary purpose of reducing the volume of the waste by removing combustible matter.

(i) "Propellant" means a fuel and oxidizer physically or chemically combined which undergoes combustion to provide rocket propulsion.

(j) "Beryllium alloy" means any metal to which beryllium has been added in order to increase its beryllium content and which contains more than 0.1 percent beryllium by weight.

(k) "Propellant plant" means any facility engaged in the mixing, casting, or machining of propellant.

§ 61.32 Emission standard.

(a) Emissions to the atmosphere from stationary sources subject to the provisions of this subpart shall not exceed 10 grams of beryllium over a 24-hour period, except as provided in paragraph (b) of this section.

(b) Rather than meet the requirement of paragraph (a) of this section, an owner or operator may request approval from the Administrator to meet an ambient concentration limit on beryllium in the vicinity of the stationary source of 0.01 $\mu g/m^3$, averaged over a 30-day period.

(1) Approval of such requests may be granted by the Administrator provided that:

(i) At least 3 years of data is available which in the judgment of the Administrator demonstrates that the future ambient concentrations of beryllium in the vicinity of the stationary source will not exceed 0.01 $\mu g/m^3$, averaged over a 30-day period. Such 3-year period shall be the 3 years ending 30 days before the effective date of this standard.

(ii) The owner or operator requests such approval in writing within 30 days after the effective date of this standard.

(iii) The owner or operator submits a report to the Administrator within 45 days after the effective date of this